

# PROJECT MANUAL



## Construction Trades II Building

Long Beach City College  
Long Beach, California

Owner	Prepared by
<p><b>Long Beach City College</b> 1305 East Pacific Coast Highway Long Beach, California 90806</p>	<p><b>Gensler</b> 500 South Figueroa Street Los Angeles, California 90071 213.327.3600</p>
	<p><b>DSA Backcheck – January 10, 2022</b></p>
	<p><b>Project Number: 005.2882.000</b></p>



**SECTION 00 01 03 - CONSULTANTS DIRECTORY**

**PART 1 - GENERAL**

**1.1 PROJECT LISTING**

**MEP Engineer:** P2S, Inc., 18575 Jamboree Road, South Tower 100, Irvine, CA 92612

**Structural Engineer:** Saiful-Bouquet, 155 North Lake Avenue, 6th Floor, Pasadena, CA 91101

**Landscape Architect:** Ridge Landscape Architecture, 8841 Research Drive, Irvine, CA 92618

**Civil Engineer:** KPFF Consulting Engineers, 700 South Flower Street, Suite 2100, Los Angeles, CA 90017

**Acoustical:** Waveguide LLC, 6060 Center Drive, Suite 870, Los Angeles, CA 90045

**Communications/IT:** Waveguide LLC, 6060 Center Drive, Suite 870, Los Angeles, CA 90045

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

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

**END OF SECTION**

**Gensler**  
005.2882.000

January 10, 2022  
DSA Back Check

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

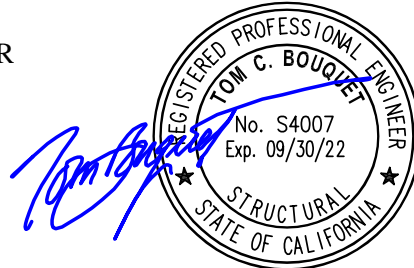
ARCHITECT  
**Gensler**  
500 South Figueroa Street  
Los Angeles, CA 90071



CIVIL ENGINEER  
**KPFF Consulting Engineers**  
700 South Flower Street  
Suite 2100  
Los Angeles, CA 90017



STRUCTURAL ENGINEER  
**Saiful-Bouquet**  
155 North Lake Avenue  
6th Floor  
Pasadena, CA 91101



PLUMBING ENGINEER  
**P2S, Inc.**  
18575 Jamboree Road  
South Tower 100  
Irvine, CA 92612



SIGNED: 08/02/2021

MECHANICAL ENGINEER  
**P2S, Inc.**  
18575 Jamboree Road  
South Tower 100  
Irvine, CA 92612

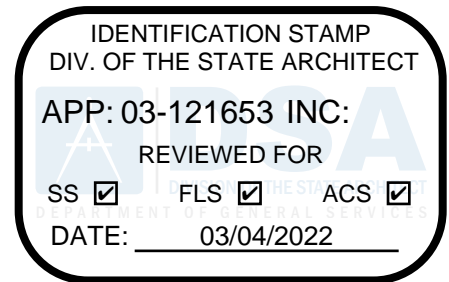


SIGNED: 08/02/2021

ELECTRICAL ENGINEER  
**P2S, Inc.**  
18575 Jamboree Road  
South Tower 100  
Irvine, CA 92612



SIGNED: 08/02/2021



Gensler  
005.2882.000

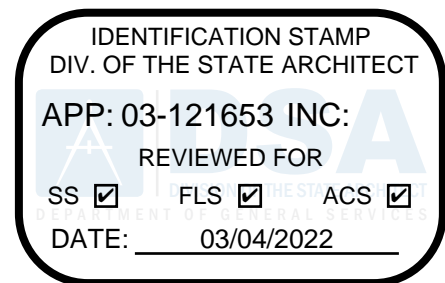
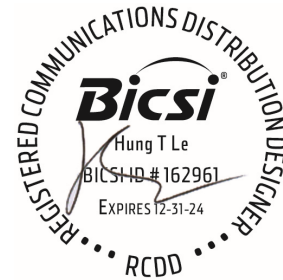
January 10, 2022  
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Long Beach City College  
Construction Trades II Building  
Long Beach, California

LANDSCAPE ARCHITECT  
**Ridge Landscape Architecture**  
8841 Research Drive  
Irvine, CA 92618



ACOUSTICAL/COMMUNICATIONS/IT  
**Waveguide, LLC**  
6060 Center Drive  
Suite 870  
Los Angeles, CA 90045



<b>PROJECT MANUAL TABLE OF CONTENTS</b>	
<i>ITEMS DATED IN BOLD ON TABLE OF CONTENTS ARE NEW OR REVISED IN THIS DOCUMENT ISSUE</i>	
<i>Document Issue Description</i>	<i>Issue Date</i>
In progress (Not included in this submittal)	In Progress
Preliminary Specifications	12/18/20
Design Development	02/12/21
50% Construction Documents	03/26/21
75% Construction Documents	05/14/21
95% Construction Documents	07/09/21
DSA Submission	08/02/21
<b>DSA Backcheck</b>	<b>01/10/22</b>

**PROCUREMENT AND CONTRACTING REQUIREMENTS GROUP**

**DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS**

**INTRODUCTORY INFORMATION**

<i>Date</i>	<i>Document No.</i>	<i>Title</i>
01/10/22	00 01 03	Consultants Directory
<b>01/10/22</b>	00 01 07	Seals Page
<b>01/10/22</b>	00 01 10	Table of Contents

**PROCUREMENT REQUIREMENTS & CONTRACTING REQUIREMENTS**

<i>Date</i>	<i>Document No.</i>	<i>Title</i>
01/10/22	00 60 00	Project Forms Submittal Transmittal Waste Management Plan Summary Waste Management Report Data Transfer Agreement Subcontractors and Major Material Suppliers List Requests for Interpretation Substitution Request Bulletin Change Order Punch List Certificate of Substantial Completion
01/10/22	00 72 00	General Conditions
01/10/22	00 73 00	Supplementary Conditions

**SPECIFICATIONS GROUP**

**GENERAL REQUIREMENTS SUBGROUP**

**DIVISION 01 - GENERAL REQUIREMENTS**

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	01 10 00	Summary
01/10/22	01 13 00	Delegated Design Requirements
01/10/22	01 14 00	Work Restrictions
<b>01/10/22</b>	01 23 00	Alternates
01/10/22	01 25 00	Substitution Procedures

01/10/22	01 26 00	Contract Modification Procedures
01/10/22	01 26 13	Requests for Interpretation (RFI)
01/10/22	01 29 00	Payment Procedures
01/10/22	01 31 00	Project Management and Coordination
01/10/22	01 32 00	Construction Progress Documentation
01/10/22	01 32 80	Hazardous Material Removal <i>(by Vista Environmental)</i>
01/10/22	01 33 00	Submittal Procedures
01/10/22	01 40 00	Quality Requirements
01/10/22	01 42 00	References
01/10/22	01 50 00	Temporary Facilities and Controls
01/10/22	01 57 23	Temporary Storm Water Pollution Control <i>(by KPFF)</i>
01/10/22	01 60 00	Product Requirements
01/10/22	01 73 00	Execution
01/10/22	01 74 19	Construction Waste Management and Disposal
01/10/22	01 77 00	Closeout Procedures
01/10/22	01 78 23	Operation and Maintenance Data
01/10/22	01 78 39	Project Record Documents
01/10/22	01 79 00	Demonstration and Training
01/10/22	01 81 19	Indoor Air Quality (IAQ) Management
01/10/22	01 81 23	CALGreen Requirements
01/10/22	01 91 13	General Commissioning Requirements <i>(by Integrated Commissioning Solutions)</i>

## FACILITY CONSTRUCTION SUBGROUP

### DIVISION 02 - EXISTING CONDITIONS

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	02 41 16	Structure Demolition <i>(by KPFF)</i>

### DIVISION 03 – CONCRETE

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	03 30 00	Cast-In-Place Concrete <i>(by Saiful Bouquet)</i>
01/10/22	03 30 05	Site Cast-In-Place Concrete <i>(by RLA)</i>
01/10/22	03 54 16	Hydraulic Cement Underlayment

### DIVISION 04 – MASONRY

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
<b>01/10/22</b>	04 26 13	Masonry Veneer

### DIVISION 05 – METALS

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	05 12 05	Structural Steel Framing <i>(by Saiful Bouquet)</i>
01/10/22	05 31 50	Steel Floor and Roof Decking <i>(by Saiful Bouquet)</i>
<b>01/10/22</b>	05 40 00	Cold-Formed Metal Framing
01/10/22	05 50 00	Metal Fabrications
01/10/22	05 52 13	Pipe and Tube Railings
01/10/22	05 52 13.16	Site Pipe and Tube Railings <i>(by RLA)</i>
01/10/22	05 70 00	Decorative Metal

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

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	06 10 53	Miscellaneous Rough Carpentry
01/10/22	06 16 00	Sheathing
<b>01/10/22</b>	06 40 23	Interior Architectural Woodwork

**DIVISION 07 - THERMAL AND MOISTURE PROTECTION**

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	07 21 00	Thermal Insulation
01/10/22	07 21 65	Wall Cladding Attachment System
01/10/22	07 25 00	Weather Barriers
01/10/22	07 26 16	Under-Slab-On-Grade Vapor Retarder
01/10/22	07 27 26	Fluid-Applied Membrane Air Barriers
01/10/22	07 42 13	Formed Metal Wall Panels
<b>01/10/22</b>	07 55 20	Modified Bituminous Membrane Roofing
01/10/22	07 62 00	Sheet Metal Flashing and Trim
01/10/22	07 72 00	Roof Accessories
01/10/22	07 84 13	Penetration Firestopping
01/10/22	07 84 43	Joint Firestopping
01/10/22	07 92 00	Joint Sealants

**DIVISION 08 - OPENINGS**

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	08 11 13	Hollow Metal Doors and Frames
<b>01/10/22</b>	08 33 23	Overhead Coiling Doors
01/10/22	08 34 73	Sound Control Doors <i>(by Waveguide LLC)</i>
01/10/22	08 36 13	Sectional Doors
01/10/22	08 41 13	Aluminum-Framed Entrances and Storefronts
01/10/22	08 44 13.13	Glazed Aluminum Window Walls
<b>01/10/22</b>	08 71 00	Door Hardware <i>(by Allegion)</i>
<b>01/10/22</b>	08 71 00.10	Door Hardware Sets <i>(by Allegion)</i>
<b>01/10/22</b>	08 71 02	Door Hardware Cut Sheets <i>(by Allegion)</i>
01/10/22	08 71 05	Acoustical Door Gaskets <i>(by Waveguide LLC)</i>
01/10/22	08 80 00	Glazing

**DIVISION 09 - FINISHES**

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	09 21 16.23	Gypsum Board Shaft-Wall Assemblies
01/10/22	09 22 16	Non-Structural Metal Framing
01/10/22	09 24 00	Cement Plastering
01/10/22	09 29 00	Gypsum Board
01/10/22	09 30 00	Tiling
01/10/22	09 51 13	Acoustical Panel Ceilings
01/10/22	09 61 23	Concrete Flooring Treatment
01/10/22	09 61 29	Processed Concrete Floor Finishes
01/10/22	09 65 13	Resilient Base and Accessories
<b>01/10/22</b>	09 68 13	Tile Carpeting
01/10/22	09 72 00	Wall Coverings
01/10/22	09 77 23	Fabric-Wrapped Panels
01/10/22	09 81 33	Acoustical Insulation, Sealants, and Accessories <i>(by Waveguide LLC)</i>
01/10/22	09 84 13	Fixed Sound Absorptive Panels <i>(by Waveguide LLC)</i>



01/10/22	09 91 13	Exterior Painting
01/10/22	09 91 23	Interior Painting
01/10/22	09 96 00.13	Exterior High-Performance Coatings
01/10/22	09 96 23	Graffiti-Resistant Coatings

**DIVISION 10 - SPECIALTIES**

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	10 14 00	Campus Signage
01/10/22	10 14 23.16	Vinyl Wall Graphics
01/10/22	10 14 73	Painted Signage
01/10/22	10 26 00	Wall and Door Protection
01/10/22	10 28 00.13	Toilet and Bath Accessories
01/10/22	10 41 16	Emergency Key Cabinet
01/10/22	10 44 00	Fire Protection Specialties

**DIVISION 11 – EQUIPMENT**

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	11 52 13	Projection Screens <i>(by Waveguide LLC)</i>

**DIVISION 12 - FURNISHINGS**

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	12 24 13	Roller Window Shades
01/10/22	12 36 16	Metal Countertops
01/10/22	12 93 00	Site Furnishings <i>(by RLA)</i>

**DIVISION 13 - SPECIAL CONSTRUCTION**

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	13 48 23	Sound and Vibration Control Assemblies <i>(by Waveguide LLC)</i>

**DIVISION 14 - CONVEYING EQUIPMENT – Not Used**

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
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DIVISIONS 15 through 19 - Reserved

**FACILITY SERVICES SUBGROUP**

DIVISION 20 - Reserved

**DIVISION 21 - FIRE SUPPRESSION *(by P2S, Inc.)***

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	21 05 17	Sleeves and Sleeve Seals for Fire Suppression Piping
01/10/22	21 05 18	Escutcheons for Fire Suppression Piping
01/10/22	21 05 53	Identification for Fire Suppression Piping and Equipment
01/10/22	21 13 13	Wet Pipe Sprinkler System

**DIVISION 22 - PLUMBING *(by P2S, Inc.)***

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	22 05 00	Common Work Results for Plumbing
01/10/22	22 05 17	Sleeves and Sleeve Seals for Plumbing Piping
01/10/22	22 05 18	Escutcheons for Plumbing Piping
01/10/22	22 05 19	Meters and Gages for Plumbing Piping
01/10/22	22 05 23	General Duty Valves for Plumbing Piping

01/10/22	22 05 29	Hangers and Supports for Plumbing Piping and Equipment
01/10/22	22 05 30	Pipe Insulation for Plumbing Piping and Equipment
01/10/22	22 05 48	Vibration and Seismic Controls for Plumbing Piping and Equipment
01/10/22	22 05 53	Identification for Plumbing Piping and Equipment
01/10/22	22 08 00	Commissioning of Plumbing <i>(by Integrated Commissioning Solutions)</i>
01/10/22	22 11 16	Domestic Water Pipe and Fittings
01/10/22	22 11 19	Domestic Water Piping Specialties
01/10/22	22 13 16	Sanitary Waste and Vent Piping
01/10/22	22 13 19	Sanitary Waste Piping Specialties
01/10/22	22 13 23	Sanitary Waste Interceptors
01/10/22	22 14 13	Storm Drainage Piping
01/10/22	22 14 23	Storm Drainage Piping Specialties
<b>01/10/22</b>	22 15 13	General Service Compressed-Air Piping
<b>01/10/22</b>	22 15 19	General Service Packaged Air Compressors and Receivers
01/10/22	22 16 19	Disinfection of Potable Water System
01/10/22	22 19 19	Sanitary Waste, Storm Drain, Vent Pipe and Fittings
01/10/22	22 33 00	Electric, Domestic-Water Heaters
01/10/22	22 40 00	Plumbing Fixtures

**DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING  
(HVAC) *(by P2S, Inc.)***

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	23 00 00	General Mechanical Requirements
01/10/22	23 05 17	Sleeves and Sleeve Seals for HVAC Piping
01/10/22	23 05 18	Escutcheons for HVAC Piping
01/10/22	23 05 19	Meters and Gages for HVAC Piping
01/10/22	23 05 23	General Duty Valves for HVAC Piping
01/10/22	23 05 29	Hangers and Supports for HVAC
01/10/22	23 05 48	Vibration and Seismic Controls for HVAC Piping and Equipment <i>(by Waveguide LLC)</i>
01/10/22	23 05 49	Variable Frequency Drives
01/10/22	23 05 53	Identification for HVAC Piping and Equipment
01/10/22	23 05 93	Testing, Adjusting, and Balancing of HVAC
01/10/22	23 07 13	Duct Insulation
01/10/22	23 07 19	HVAC Piping Insulation
01/10/22	23 08 00	Commissioning of Mechanical <i>(by Integrated Commissioning Solutions)</i>
01/10/22	23 09 00	Instrumentation and Control for HVAC
01/10/22	23 09 93	Sequence and Operations for HVAC Controls
01/10/22	23 21 13	Hydronic Piping
01/10/22	23 21 13.13	Underground Hydronic Piping
01/10/22	23 21 16	Hydronic Piping Specialties
01/10/22	23 31 13	Metal Ducts
01/10/22	23 33 00	Air Duct Accessories
01/10/22	23 33 19	Duct Silencers <i>(by Waveguide LLC)</i>
01/10/22	23 34 00	Exhaust Fan Noise Requirements <i>(by Waveguide LLC)</i>
01/10/22	23 34 23	HVAC Fans
01/10/22	23 36 00	Air Terminal Units
01/10/22	23 37 13	Diffusers, Registers and Grilles
01/10/22	23 74 13	Custom Air Handling Units
01/10/22	23 74 14	Semi-Custom Air Handling Units

01/10/22 23 74 15 Air Handling Unit Noise Requirements *(by Waveguide LLC)*

DIVISION 24 - Reserved

**DIVISION 25 - INTEGRATED AUTOMATION – Not Used**

**DIVISION 26 – ELECTRICAL *(by P2S, Inc.)***

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	26 00 10	Basic Electrical Requirements
01/10/22	26 05 19	Low-Voltage Power Conductors and Cables
01/10/22	26 05 26	Grounding and Bonding for Electrical Systems
01/10/22	26 05 29	Hangers and Supports for Electrical Systems
01/10/22	26 05 33	Raceways and Boxes for Electrical Systems
01/10/22	26 05 43	Underground Duct and Raceways for Electrical Systems
01/10/22	26 05 44	Sleeves and Sleeve Seals for Electrical Raceways and Cabling
01/10/22	26 05 48	Vibration and Seismic Controls for Electrical Systems
01/10/22	26 05 53	Identification for Electrical Systems
01/10/22	26 08 00	Commissioning of Electrical <i>(by Integrated Commissioning Solutions)</i>
01/10/22	26 09 13	Electrical Power Monitoring and Control
01/10/22	26 09 43	Network Lighting Controls
01/10/22	26 22 00	Low Voltage Transformers
01/10/22	26 24 13	Switchboards
01/10/22	26 24 16	Panelboards
01/10/22	26 27 26	Wiring Devices
01/10/22	26 28 13	Fuses
01/10/22	26 28 16	Enclosed Switches and Circuit Breakers
01/10/22	26 33 23	Central Battery Equipment
01/10/22	26 51 00	Interior Lighting
01/10/22	26 56 00	Exterior Lighting

**DIVISION 27 - COMMUNICATIONS *(by Waveguide LLC)***

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	27 00 00	General Communications Requirements
01/10/22	27 05 26	Grounding and Bonding for Communications Systems
01/10/22	27 05 28	Pathways for Communications Systems
01/10/22	27 08 00	Commissioning for Communications Systems
01/10/22	27 11 00	Communications Equipment Room Fittings
01/10/22	27 13 00	Communications Backbone Cabling
01/10/22	27 15 00	Communications Horizontal Cabling
01/10/22	27 51 26	Assistive Listening System
01/10/22	27 51 27	Emergency Phone

**DIVISION 28 - ELECTRONIC SAFETY AND SECURITY *(by P2S, Inc.)***

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
<b>01/10/22</b>	<b>28 31 11</b>	<b>Digital, Addressable Fire-Alarm System</b>

DIVISION 29 - Reserved

**SITE AND INFRASTRUCTURE SUBGROUP**

DIVISION 30 - Reserved

**DIVISION 31 - EARTHWORK (by KPFF)**

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	31 20 00	Earth Moving

**DIVISION 32 - EXTERIOR IMPROVEMENTS**

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	32 08 00	Commissioning of Exterior Improvements (by Integrated Commissioning Solutions)
01/10/22	32 13 13	Concrete Paving (by KPFF)
01/10/22	32 13 13.16	Concrete Paving (by RLA)
01/10/22	32 13 73	Concrete Pavement Joint Sealants (by KPFF)
01/10/22	32 13 73.16	Concrete Paving Joint Sealants (by RLA)
01/10/22	32 31 13	Chain Link Fences and Gates (by RLA)
01/10/22	32 31 19	Decorative Metal Fences and Gates (by RLA)
01/10/22	32 84 00	Planting Irrigation (Reclaimed Water) (by RLA)
01/10/22	32 91 13	Soil Preparation (by RLA)
01/10/22	32 92 00	Turf and Grasses (by RLA)
01/10/22	32 93 00	Plants (by RLA)

**DIVISION 33 – UTILITIES (by KPFF)**

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	33 11 00	Water Utility Distribution Piping
01/10/22	33 31 00	Sanitary Utility Sewage Piping
01/10/22	33 41 00	Storm Utility Drainage Piping

**DIVISION 34 - TRANSPORTATION - Not Used**

**DIVISION 35 - WATERWAY AND MARINE CONSTRUCTION - Not Used**

DIVISIONS 36 through 39 - Reserved

**PROCESS EQUIPMENT SUBGROUP**

**DIVISION 40 - PROCESS INTEGRATION – Not Used**

**DIVISION 41 - MATERIAL PROCESSING AND HANDLING EQUIPMENT – Not Used**

**DIVISION 42 - PROCESS HEATING, COOLING, AND DRYING EQUIPMENT – Not Used**

**DIVISION 43 - PROCESS GAS AND LIQUID HANDLING, PURIFICATION AND STORAGE EQUIPMENT – Not Used**

**DIVISION 44 - POLLUTION CONTROL EQUIPMENT (by P2S, Inc.)**

<i>Date</i>	<i>Section No.</i>	<i>Title</i>
01/10/22	44 11 16	Dust Collection Systems

**DIVISION 45 - INDUSTRY-SPECIFIC MANUFACTURING EQUIPMENT – Not Used**

**DIVISION 46 - WATER AND WASTEWATER EQUIPMENT – Not Used**

DIVISION 47 - Reserved

**DIVISION 48 - ELECTRICAL POWER GENERATION – Not Used**

DIVISION 49 - Reserved

END OF TABLE OF CONTENTS

## DOCUMENT 00 60 00 - PROJECT FORMS

### PART 1 - GENERAL

#### 1.1 FORM OF AGREEMENT AND GENERAL CONDITIONS

- A. The following form of Owner/Contractor Agreement and form of the General Conditions shall be used for Project:
1. AIA Document A101, "Standard Form of Agreement between Owner and Contractor, Stipulated Sum."
    - a. The General Conditions for Project are specified in Document 00 72 00.
    - b. Supplementary Conditions are specified in Document 00 73 00.

#### 1.2 ADMINISTRATIVE FORMS

- A. Copies of AIA standard forms may be obtained from the American Institute of Architects; <http://www.aia.org/contractdocs/purchase/index.htm>; [docspurchases@aia.org](mailto:docspurchases@aia.org); (800) 942-7732.
- B. Pre-Construction Forms:
1. Form of Performance Bond and Labor and Material Bond: AIA Document A312, "Performance Bond and Payment Bond."
  2. Form of Certificate of Insurance: AIA Document G715, "Supplemental Attachment for ACORD Certificate of Insurance 25-S."
- C. Information and Modification Forms: Attached at the end of this Section.
1. Submittal Transmittal. (Referenced in Section 01 33 00)
  2. Data Transfer Agreement. (Referenced in Section 01 33 00)
  3. Subcontractors and Major Material Suppliers List. (Referenced in Section 01 33 00)
  4. Requests for Interpretation (RFI). (Referenced in Section 01 26 13)
  5. Substitution Request. (Referenced in Section 01 25 00)
  6. Bulletin. (Referenced in Section 01 26 00)
  7. Change Order Form. (Referenced in Section 01 26 00)
  8. Punch List. (Referenced in Section 01 77 00)
  9. Certificate of Substantial Completion. (Referenced in Section 01 77 00)
- D. Payment Forms:
1. Schedule of Values Form: AIA Document G703, "Continuation Sheet."
  2. Payment Application: AIA Document G702/703, "Application and Certificate for Payment and Continuation Sheet."
  3. Form of Contractor's Affidavit: AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."

4. Form of Affidavit of Release of Liens: AIA Document G706A, "Contractor's Affidavit of Payment of Release of Liens."

E. Waste Management Forms:

1. Waste Management Plan Summary. (Referenced in Section 01 74 19)
2. Waste Management Report. (Referenced in Section 01 74 19)

**END OF DOCUMENT 00 60 00**



SUBMITTAL TRANSMITTAL

Project: \_\_\_\_\_ Date: \_\_\_\_\_
A/E Project Number: \_\_\_\_\_

TRANSMITTAL A To (Contractor): \_\_\_\_\_ Date: \_\_\_\_\_ Submittal No. \_\_\_\_\_
From (Subcontractor): \_\_\_\_\_ By: \_\_\_\_\_ [ ] Resubmission

Table with 4 columns: Qty., Reference / Number, Title / Description / Manufacturer, Spec. Section Title and Paragraph / Drawing Detail Reference

- Submitted for review and approval
Resubmitted for review and approval
Complies with contract requirements
Will be available to meet construction schedule
A/E review time included in construction schedule
Substitution involved - Substitution request attached
If substitution involved, submission includes point-by-point comparative data or preliminary details
Items included in submission will be ordered immediately upon receipt of approval

Other remarks on above submission: [ ] One copy retained by sender

TRANSMITTAL B To (A/E): \_\_\_\_\_ Attn: \_\_\_\_\_ Date Rec'd by Contractor: \_\_\_\_\_
From (Contractor): \_\_\_\_\_ By: \_\_\_\_\_ Date Trnsmt'd by Contractor: \_\_\_\_\_

- Approved
Approved as noted
Revise / Resubmit
Rejected / Resubmit

Other remarks on above submission: [ ] One copy retained by sender

TRANSMITTAL C To (Contractor): \_\_\_\_\_ Attn: \_\_\_\_\_ Date Rec'd by A/E: \_\_\_\_\_
From (A/E): \_\_\_\_\_ [ ] Other By: \_\_\_\_\_ Date Trnsmt'd by A/E: \_\_\_\_\_

- Approved
Approved as noted
Not subject to review
No action required
Revise / Resubmit
Rejected / Resubmit
Approved as noted / Resubmit
Provide file copy with corrections identified
Sepia copies only returned
Point-by-point comparative data required to complete approval process
Submission Incomplete / Resubmit

Other remarks on above submission: [ ] One copy retained by sender

TRANSMITTAL D To (Subcontractor): \_\_\_\_\_ Attn: \_\_\_\_\_ Date Rec'd by Contractor: \_\_\_\_\_
From (Contractor): \_\_\_\_\_ By: \_\_\_\_\_ Date Trnsmt'd by Contractor: \_\_\_\_\_

Copies: [ ] Owner [ ] Consultants [ ] \_\_\_\_\_ [ ] \_\_\_\_\_ [ ] \_\_\_\_\_ [ ] One copy retained by sender





# Waste Management Plan Summary

(Submit after Award of Contract and prior to Start of Work)

LBCC Construction Trades II Building		
Contract or Work Order No.:		
Contractor's Name:		
Street Address:		
City:	State:	Zip:
Phone: ( )	Fax: ( )	
E-Mail Address:		
Prepared by: (Print Name)		
Date Submitted:		
Project Period:	From:	To:

Reuse, Recycling or Disposal Processes to Be Used
<p><i>Describe the types of recycling processes or disposal activities that will be used for material generated in the project to achieve the required 80% diversion rate. Indicate the type of process or activity by number, types of materials, and estimated quantities that will be recycled or disposed in the sections below:</i></p> <p>01 - Reuse of building materials or salvage items on site (i.e. crushed base or red clay brick)</p> <p>02 - Salvaging building materials or salvage items at an off site salvage or re-use center (i.e. lighting, fixtures)</p> <p>03 - Recycling source separated materials on site (i.e. crushing asphalt/concrete for reuse or grinding for mulch)</p> <p>04 - Recycling source separated materials at an off site recycling center (i.e. scrap metal or green matls)</p> <p>05 - Recycling commingled loads of C&amp;D matls at an off site mixed debris recycling center or transfer station</p> <p>06 - Recycling material as Alternative Daily Cover at landfills</p> <p>07 - Delivery of soils or mixed inerts to an inert landfill for disposal (inert fill).</p> <p>08 - Disposal at a landfill or transfer station.</p> <p>09 - Other (please describe)</p>

Types of Material to Be Generated
<p><i>Use these codes to indicate the types of material that will be generated on the project</i></p> <p>A = Asphalt                  C = Concrete                  M = Metals                  I = Mixed Inert      G = Green Matls</p> <p>D = Drywall                  P/C=Paper/Cardboard          W/C = Wire/Cable          W = Wood                  O = Other (describe)</p> <p>M/C = Miscellaneous Construction Debris          R = Reuse/Salvage          S= Soils (Non Hazardous)</p> <p>Facilities Used: Provide Name of Facility and Location (City)</p> <p>Total Truck Loads: Provide Number of Trucks Hauled from Site During Reporting Period</p> <p>Total Quantities: If scales are available at sites, report in tons. If not, quantify by cubic yards. For salvage/reuse items, quantify by estimated weight (or units).</p>

SECTION 1 - RE-USED/RECYCLED MATERIALS						
<i>Include all recycling activities for source separated or mixed material recycling centers where recycling will occur.</i>						
Type of Material	Type of Activity	Facility to Be Used / Location	Total Truck Loads	Total Quantities		
				Tons	Cubic Yd.	Other Wt.
a. Total Diversion						

**SECTION 2 - DISPOSED MATERIALS**

*Include all disposal activities for landfills, transfer stations, or inert landfills where no recycling will occur.*

Type of Material	Type of Activity	Facility to Be Used / Location	Total Truck Loads	Total Quantities		
				Tons	Cubic Yd.	Other Wt.
b. Total Disposal						

**SECTION 3 - TOTAL MATERIALS GENERATED**

*This section calculates the total materials to be generated during the project period (Reuse/Recycle + Disposal = Generation)*

				Tons	Cubic Yd.	Other Wt.
a. Total Reused/Recycled						
b. Total Disposed						
c. Total Generated						

**SECTION 4 - CONTRACTOR'S LANDFILL DIVERSION RATE CALCULATION**

*Add totals from Section 1 + Section 2*

	Tons	Cubic Yards	Other Wt.		
a. Materials Re-Used and Recycled					
b. Materials Disposed					
c. Total Materials Generated (a. + b. = c.)					
d. Landfill Diversion Rate (Tons Only)* (a / c)				<b>Min. 80% Diversion Required</b>	

\* Use tons only to calculate recycling percentages:  $Tons\ Reused/Recycled / Tons\ Generated = \% \text{ Recycled}$

Contractor's Comments (Provide any additional information pertinent to planned reuse, recycling, or disposal activities):

**Notes:**

- 1. Suggested Conversion Factors: From Cubic Yards to Tons (Use when scales are not available)
  - Asphalt: 0.61 (ex. 1000 CY Asphalt = 610 tons. Applies to broken chunks of asphalt)
  - Concrete: 0.93 (ex. 1000 CY Concrete = 930 tons. Applies to broken chunks of concrete)
  - Gypsum Board Scrap: 0.20
  - Ferrous Metals: 0.22 (ex. 1000 CY Ferrous Metal = 220 tons)
  - Non-Ferrous Metals: 0.10 (ex. 1000 CY Non-Ferrous Metals = 100 tons)
  - Wood Scrap: 0.16

# Waste Management Report

(Submit with Each Progress Payment)

**Gensler**

LBCC Construction Trades II Building		
Contract or Work Order No.:		
Contractor's Name:		
Street Address:		
City:	State:	Zip:
Phone: ( )	Fax: ( )	
E-Mail Address:		
Prepared by: (Print Name)		
Date Submitted:		
Project Period:	From:	To:

### Reuse, Recycling or Disposal Processes to Be Used

*Describe the types of recycling processes or disposal activities that will be used for material generated in the project to achieve the required 80% diversion rate. Indicate the type of process or activity by number, types of materials, and estimated quantities that will be recycled or disposed in the sections below:*

- 01 - Reuse of building materials or salvage items on site (i.e. crushed base or red clay brick)
- 02 - Salvaging building materials or salvage items at an off site salvage or re-use center (i.e. lighting, fixtures)
- 03 - Recycling source separated materials on site (i.e. crushing asphalt/concrete for reuse or grinding for mulch)
- 04 - Recycling source separated materials at an off site recycling center (i.e. scrap metal or green matls)
- 05 - Recycling commingled loads of C&D matls at an off site mixed debris recycling center or transfer station
- 06 - Recycling material as Alternative Daily Cover at landfills
- 07 - Delivery of soils or mixed inerts to an inert landfill for disposal (inert fill).
- 08 - Disposal at a landfill or transfer station.
- 09 - Other (please describe)

### Types of Material to Be Generated

*Use these codes to indicate the types of material that will be generated on the project*

- |   |                     |                          |                 |                      |
|---|---------------------|--------------------------|-----------------|----------------------|
| A = Asphalt                             | C = Concrete        | M = Metals               | I = Mixed Inert | G = Green Matls      |
| D = Drywall                             | P/C=Paper/Cardboard | W/C = Wire/Cable         | W = Wood        | O = Other (describe) |
| M/C = Miscellaneous Construction Debris | R = Reuse/Salvage   | S= Soils (Non Hazardous) |                 |                      |

Facilities Used: Provide Name of Facility and Location (City)

Total Truck Loads: Provide Number of Trucks Hauled from Site During Reporting Period

Total Quantities: If scales are available at sites, report in tons. If not, quantify by cubic yards. For salvage/reuse items, quantify by estimated weight (or units).

### SECTION 1 - RE-USED/RECYCLED MATERIALS

*Include all recycling activities for source separated or mixed material recycling centers where recycling will occur.*

Type of Material	Type of Activity	Facility to Be Used / Location	Total Truck Loads	Total Quantities		
				Tons	Cubic Yd.	Other Wt.
a. Total Diversion						

**SECTION 2 - DISPOSED MATERIALS**

*Include all disposal activities for landfills, transfer stations, or inert landfills where no recycling will occur.*

Type of Material	Type of Activity	Facility to Be Used / Location	Total Truck Loads	Total Quantities		
				Tons	Cubic Yd.	Other Wt.
b. Total Disposal						

**SECTION 3 - TOTAL MATERIALS GENERATED**

*This section calculates the total materials to be generated during the project period (Reuse/Recycle + Disposal = Generation)*

				Tons	Cubic Yd.	Other Wt.
a. Total Reused/Recycled						
b. Total Disposed						
c. Total Generated						

**SECTION 4 - CONTRACTOR'S LANDFILL DIVERSION RATE CALCULATION**

*Add totals from Section 1 + Section 2*

	Tons	Cubic Yards	Other Wt.		
a. Materials Re-Used and Recycled					
b. Materials Disposed					
c. Total Materials Generated (a. + b. = c.)					
d. Landfill Diversion Rate (Tons Only)* (a / c)					

*\* Use tons only to calculate recycling percentages: Tons Reused/Recycled/Tons Generated = % Recycled*

Contractor's Comments (Provide any additional information pertinent to planned reuse, recycling, or disposal activities):

- Notes:
- Suggested Conversion Factors: From Cubic Yards to Tons (Use when scales are not available)
    - Asphalt: 0.61 (ex. 1000 CY Asphalt = 610 tons. Applies to broken chunks of asphalt)
    - Concrete: 0.93 (ex. 1000 CY Concrete = 930 tons. Applies to broken chunks of concrete)
    - Gypsum Board Scrap: 0.20
    - Ferrous Metals: 0.22 (ex. 1000 CY Ferrous Metal = 220 tons)
    - Non-Ferrous Metals: 0.10 (ex. 1000 CY Non-Ferrous Metals = 100 tons)
    - Wood Scrap: 0.16

# Data Transfer Agreement

<b>Entity Requesting Data ("Transferee")</b>	<b>Transferee Contact Name</b>
<b>Project</b>	<b>Project Number</b>
<b>Client</b>	<b>Date</b>
<b>File 1DTA This is page 1 of</b>	

Transferee has asked Gensler to provide electronic copies of, or access to, certain drawings, specifications, or other documents, CAD data files, and/or building information models (collectively, "Data") prepared by Gensler and/or its consultants (collectively "Gensler") for the Project. Gensler agrees to provide Transferee with the requested Data, under the terms of this Data Transfer Agreement ("Agreement").

1. The transfer of the Data is not and shall not be deemed a sale. The Data are instruments of service. Gensler shall be deemed the Data's author and shall retain all proprietary rights, including any copyrights, embodied therein.
2. Transferee may transfer the Data to its contractors, subcontractors, suppliers, and consultants (collectively "Others"), provided Transferee requires the Others to be bound by this Agreement as if they were the Transferee in this Agreement. Transferee and Others may use the Data only for purposes related to the Project.
3. Transferee acknowledges that anomalies and errors may occur when the Data is transferred electronically or used in an incompatible computer environment. Transferee solely accepts the risks associated with, and the responsibility for, any damages to hardware, software, computer systems, or networks related to the Data's transfer or use. Gensler shall have no responsibility to provide software or training to allow Transferee to use the Data.
4. Gensler shall have no duty to modify or update the Data. Gensler may retain an archival copy of the Data, which shall be conclusive proof and govern in any dispute over the Data's form or content.
5. Transferee agrees to indemnify, defend and hold Gensler, its officers, directors, shareholders, employees, agents, and consultants harmless from and against any and all claims, liabilities, suits, demands, losses, damages, costs, and expenses, including, but not limited to, reasonable attorneys' fees and all legal expenses and fees incurred through appeal, and all interest thereon, accruing to or resulting from any and all persons, firms or any other legal entities on account of any damages or losses to property or persons, including, but not limited to, injuries, death or economic losses, arising out of Transferee's or Others' use, reuse, transfer, or modification of the Data, except where a court or forum of competent jurisdiction determines that Gensler is solely liable for such damages or losses.
6. If Transferee fails to perform or observe any of the terms of this Agreement, Gensler may demand, and Transferee immediately shall return, the Data and any copies thereof.
7. To the extent the Data include building information models ("Models"), the parties agree to the following additional terms: (i) The Models are intended for the purpose of communicating design intent. While they may be helpful to illustrate conflicts or inconsistencies in the design, the Models may not detect all conflicts or inconsistencies. (ii) Any use of the Models for the purpose of generating quantity take-offs or cost estimates, or for fabrication, will be at the Transferee's sole risk. (iii) As with Gensler's other services and deliverables, the Models will be prepared using that degree of skill and care exercised by licensed professionals practicing in the same community, under the same or similar circumstances. The Models may contain, or be based upon, data or information provided by others. Gensler has relied upon such data or information as is consistent with this standard of care. (iv) Information contained in the Models will not be construed to dictate construction means or methods, which will remain the contractor's responsibility. (v) To the extent of any conflict between information contained in, or generated by, the Models and Gensler's drawings and specifications, the latter documents will prevail.
8. This Agreement shall be governed by the law of the location of Gensler's office identified at the bottom of this Agreement.
9. In any legal proceeding to enforce this Agreement, the prevailing party shall be entitled to recover its reasonable attorneys' fees and costs of defense.
10. Unless otherwise explicitly agreed to in writing by the parties, this Agreement shall govern any and all future data transfers to Transferee by Gensler.

<b>Gensler Authorization by</b>	<b>Date Signed</b>
_____	_____
Input Principal or Managing Principal's name here	

<b>Transferee Authorization by</b>	<b>Date Signed</b>
_____	_____





Advancement  
of Construction  
Technology

# SUBCONTRACTORS AND MAJOR MATERIAL SUPPLIERS LIST

Project: \_\_\_\_\_ From (Contractor): \_\_\_\_\_

To (A/E): \_\_\_\_\_ Date: \_\_\_\_\_

A/E Project Number: \_\_\_\_\_

Contract For: \_\_\_\_\_

List Subcontractors and Major Material Suppliers proposed for use on this Project as required by the Construction Documents. Attach supplemental sheets if necessary.

Section Number	Section Title	Firm	Address	Phone Number (Fax Number)	Contact
----------------	---------------	------	---------	---------------------------	---------

Attachments

Signed by: \_\_\_\_\_

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

Copies:  Owner  Consultants  \_\_\_\_\_  \_\_\_\_\_  \_\_\_\_\_  File





# Request for Interpretation

**Gensler**

<b>Project</b>	<b>RFI Number</b>
<b>To</b>	<b>Date</b>
<b>Attention</b>	<b>Project Number</b>
<b>From</b>	<b>File</b> 6RFI
<b>Issued By</b>	<b>Drawing Sheet / Location</b>
<b>Subject</b>	<b>Detail</b>
<b>Distribution</b>	<b>Specifications Page Number</b>
	<b>This is page</b> 1 of

Problem, Cause and Proposed Solution (attach sketches as necessary)

**Effect on Schedule**

**Effect on Cost**

**Reply**

**Reply Needed by**

**Signature** **Date**





# SUBSTITUTION REQUEST

(After the Bidding/Negotiating Phase)

Project: \_\_\_\_\_ Substitution Request Number: \_\_\_\_\_  
 \_\_\_\_\_  
 From: \_\_\_\_\_  
 To: \_\_\_\_\_ Date: \_\_\_\_\_  
 \_\_\_\_\_  
 A/E Project Number: \_\_\_\_\_  
 Re: \_\_\_\_\_ Contract For: \_\_\_\_\_

Specification Title: \_\_\_\_\_ Description: \_\_\_\_\_  
 Section: \_\_\_\_\_ Page: \_\_\_\_\_ Article/Paragraph: \_\_\_\_\_

Proposed Substitution: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Phone: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 Trade Name: \_\_\_\_\_ Model No.: \_\_\_\_\_  
 Installer: \_\_\_\_\_ Phone: \_\_\_\_\_  
 Address: \_\_\_\_\_

History:  New product  1-4 years old  5-10 years old  More than 10 years old

Differences between proposed substitution and specified product:

Point-by-point comparative data attached — REQUIRED BY A/E

Reason for not providing specified item: \_\_\_\_\_

Similar Installation:

Project: \_\_\_\_\_ Architect: \_\_\_\_\_  
 Address: \_\_\_\_\_ Owner: \_\_\_\_\_  
 \_\_\_\_\_ Date Installed: \_\_\_\_\_

Proposed substitution affects other parts of Work:  No  Yes; explain \_\_\_\_\_

Savings to Owner for accepting substitution: \_\_\_\_\_ (\$ \_\_\_\_\_).

Proposed substitution changes Contract Time:  No  Yes [Add] [Deduct] \_\_\_\_\_ days.

Supporting Data Attached:  Drawings  Product Data  Samples  Tests  Reports  \_\_\_\_\_

# SUBSTITUTION REQUEST

(After the Bidding/Negotiating Phase — Continued)

---

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
  - Same warranty will be furnished for proposed substitution as for specified product.
  - Same maintenance service and source of replacement parts, as applicable, is available.
  - Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
  - Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
  - Proposed substitution does not affect dimensions and functional clearances.
  - Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
  - Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.
- 

Submitted by: \_\_\_\_\_

Signed by: \_\_\_\_\_

Firm: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone: \_\_\_\_\_

Attachments:

---

## A/E's REVIEW AND ACTION

- Substitution approved - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures.
- Substitution approved as noted - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures.
- Substitution rejected - Use specified materials.
- Substitution Request received too late - Use specified materials.

Signed by: \_\_\_\_\_ Date: \_\_\_\_\_

---

Additional Comments:  Contractor  Subcontractor  Supplier  Manufacturer  A/E  
 Other:

---

**Project** \_\_\_\_\_ **Date** \_\_\_\_\_

---

**Project Location** \_\_\_\_\_ **Architect's Project Number** \_\_\_\_\_

---

**Owner/Client** \_\_\_\_\_ **File** 6BL **This is page** 1 **of** \_\_\_\_\_

---

**To** \_\_\_\_\_ **Attention** \_\_\_\_\_

---

**Address** \_\_\_\_\_

---

**City** \_\_\_\_\_ **State** \_\_\_\_\_ **Zip Code** \_\_\_\_\_

---

**Delivered via:**       **Messenger**       **Hand carried**       **Facsimile**  
 **Express**       **Pick-up**       **E-mail Address**  
 **Mail**       **UPS**       **Website Address**

---

**This Bulletin Conveys to Contractor** (Check one of the following five choices.):

- Architect's Authorization for Minor Changes**  
Architect recommends modifications to the Work as described below.
- Architect's Clarification / Supplemental Instructions** (Use this Bulletin form in place of *Architect's Supplemental Instructions* form.)  
Contractor shall carry out the Work in accordance with the following supplemental instructions.
- Architect's Confirmation of a Field Order** (Use this Bulletin form in place of a *Field Order* form.)  
This confirms Architect's verbal instructions to (individual's name) \_\_\_\_\_ on (date) \_\_\_\_\_, as described below.  
Note: The above three choices are each subject to the following terms: The change(s), clarification(s) and/or confirmation(s) described below is/are issued in accordance with the Contract Documents, without change in Contract Sum and/or Time.
- Architect's Request for Contractor's Proposal** (Use this Bulletin form in place of an *Estimate Request* form.)  
Please submit an itemized proposal for changes in the Contract Sum and/or Time for proposed modifications to the Contract Documents described herein. Submit proposal **within \_\_\_\_\_ days** or notify the Architect in writing of the date on which you anticipate submitting your proposal. This is not a Change Order or a Construction Change Directive or a direction to proceed with the Work described in the proposed modifications.
- Other:** As described below.

---

**Attachments**

---

**Requested by**  
 Architect     Owner     Contractor     Other (specify): \_\_\_\_\_

---

**Issued by Gensler by** \_\_\_\_\_ **Date Signed** \_\_\_\_\_

---

**Issued by Owner by** \_\_\_\_\_ **Date Signed** \_\_\_\_\_  
 Required; Please return signed copy to Gensler     Not Required

---

**Accepted by Contractor by** \_\_\_\_\_ **Date Signed** \_\_\_\_\_  
 Required; Please return signed copy to Gensler     Not Required

---

**Distribution**

---

**Prepared by Gensler by** \_\_\_\_\_ **Date Signed** \_\_\_\_\_

---

**Instructions / Description / References / Dates**

Begin text here...



# Change Order Number

# Gensler

---

<b>Project</b>	<b>Date</b>
----------------	-------------

---

<b>Project Location</b>	<b>Project Number</b>
-------------------------	-----------------------

---

<b>Owner / Client</b>	<b>File</b> 6CO	<b>This is page</b> 1	<b>of</b>
-----------------------	-----------------	-----------------------	-----------

---

<b>Contractor</b>	<b>Contractor's Request / Quotation Number / Date</b>
-------------------	---

---

<b>Change to Contract Sum:</b> Choose One:	<b>Change to Contract Time:</b>
--	---------------------------------

---

<b>Original Contract Amount:</b> Choose One:	<b>Revised Contract Amount:</b> Choose One:
--	---

---

**See Change Order Summary for Revised Total Contract Amount and Time**

---

<b>Reason for Change</b>	<b>Requested by</b>
--------------------------	---------------------

---

<b>Recommended for Approval by Gensler: by</b>	<b>By Por</b>	<b>Date Signed</b>
--	---------------	--------------------

---

<b>Approved for Owner / Client</b>	<b>By</b>	<b>Date Signed</b>
------------------------------------	-----------	--------------------

---

<b>Approved for Contractor</b>	<b>By</b>	<b>Date Signed</b>
--------------------------------	-----------	--------------------

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<b>Approved for Tenant (if applicable)</b>	<b>By</b>	<b>Date Signed</b>
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The above Change Order to the contract shall be effective upon signature by all applicable parties, in accordance with the Conditions of the Contract. The Contract Amount refers to the Contract Sum or guaranteed Maximum Cost in the Contract.

---

**Distribution**

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**Description / References / Costs / Dates**

Begin text here . . .

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# Punch List

# Gensler

---

<b>Project</b>	<b>Date of Observation</b>	
<b>Project Location</b>	<b>Project Number</b>	
<b>List Number</b>	<b>File</b>	6PL
	<b>This is page</b>	1 of

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**Present**

Field review by Gensler disclosed the item(s) listed below, which is/are not in accordance with the Contract Documents. Contractor shall, upon receipt of this list, and before Gensler issues the Certificate of Substantial Completion, proceed promptly to complete and correct the item(s) and shall then submit a request for another field review by Gensler to determine Substantial Completion. This list supplements Contractor's Punch List and, unless otherwise noted, supersedes Gensler's previous list(s). Gensler will rely on this list as the approved record of matters discussed and conclusions reached, unless Contractor's written notice to the contrary is received by Gensler within seven calendar days of the date this list was issued.

**Distribution**

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<b>Prepared by</b>	<b>Date Issued</b>
--------------------	--------------------

---

**Space / Item Number / Descriptions / Observations**

---



# Certificate of Substantial Completion

<b>Project</b>	<b>Project Number</b>	
<b>Project Location</b>	<b>Date Issued</b>	
<b>Owner / Client</b>	<b>File</b>	6SC
<b>Contract Date</b>	<b>This is Page</b>	1of

**Date of Substantial Completion**

<b>Date of Substantial Completion is applicable to</b>	<input type="checkbox"/> <b>Entire Project</b>	<input type="checkbox"/> <b>Designated Portion of Project, as described below</b>
<b>Punch List</b>	<input type="checkbox"/> <b>Attached</b>	<input type="checkbox"/> <b>Transmitted Separately</b> <input type="checkbox"/> <b>None</b>

The Work performed under the Contract for Construction has been reviewed and found, to Architect's best knowledge, information and belief, to be substantially complete as of the Date of Substantial Completion entered above. The Date of Substantial Completion is the date when the Work, or designated portion thereof, is sufficiently complete in accordance with the Contract Documents (including any approved change Orders) and all required final inspections and permits have been obtained so Owner can occupy or utilize the Work for its intended use, subject only to completion of minor items (Punch List).

The Work, or designated portion thereof shall include:

A list of items to be completed or corrected and the date(s) when such items are to be completed (Punch List) may be attached hereto or transmitted separately. This Certificate of Substantial Completion or omission of any item from the Punch List shall not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. The Architect shall not be responsible for any omission from, or other discrepancy on, the Punch List. Contractor agrees to complete or correct the items listed on the Punch List within \_\_\_\_\_ days of the above date of Substantial Completion.

Warranties required under the Contract Documents shall commence on the Date of Substantial Completion, except for Punch List items and other incomplete work, warranties for which shall commence on the date such work is satisfactorily completed, unless otherwise agreed in writing by Owner and Contractor.

The Owner and Contractor shall fulfill and transfer responsibilities with regard to insurance, utilities, maintenance, damage, security, surety, and the like, in accordance with the Contract Documents or other written agreement between them.

The Architect has conducted no tests for, and made no determination of the presence or lack of asbestos or other hazardous or toxic substances or pollutants.

The Basic Services of the Architect shall end 30 days after the Date of Substantial Completion, unless otherwise stated in the Owner/Architect Agreement or agreed in writing.

Begin text here . . .

<b>Architect</b>	Gensler	<b>By</b>	<b>Date Signed</b>
<b>Owner / Client</b>		<b>By</b>	<b>Date Signed</b>
<b>Contractor</b>		<b>By</b>	<b>Date Signed</b>



**DOCUMENT 00 72 00 - GENERAL CONDITIONS**

**PART 1 - GENERAL**

- A. General Conditions of the Contract for Construction, AIA Document A201, 2007 Edition, hereinafter referred to as General Conditions, are hereby made a part of the Contract Documents.
- B. The Contractor is hereby specifically directed, as a condition of the Contract, to become acquainted with the Articles contained therein, and to notify and apprise all Subcontractors and other parties to the Contract of, and bind them to, its conditions.
- C. No contractual adjustments shall be due as a result of failure on the part of the Contractor, Subcontractors or other parties to the Contract to be fully acquainted with the General Conditions.
- D. The General Conditions of the Contract may be amended by Supplementary Conditions.
- E. The provisions of the General and Supplementary Conditions, when included, and Division 01 "General Requirements," apply to the Work specified in each Section of the Specifications.
- F. Where conflicts occur concerning the Architect's duties and responsibilities between the General Conditions and the Agreement between the Owner and Architect, the Agreement shall take precedence.
- G. If not otherwise included in the Owner-Contractor Agreement or specifically included in the bidding documents, the Contractor shall obtain the Owner's insurance requirements prior to submitting a bid.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF DOCUMENT 00 72 00**

## DOCUMENT 00 73 00 - SUPPLEMENTARY CONDITIONS

AIA Document A201-2007, in its entirety, shall constitute the General Conditions of the Contract for Construction (the "General Conditions"). These Supplementary Conditions of the Contract for Construction ("Supplementary Conditions") are attached to and made a part of the Contract Documents and are intended to modify and/or supplement the General Conditions. Capitalized terms used herein but not defined herein shall have the same meanings as in the General Conditions.

---

### ARTICLE 1 GENERAL PROVISIONS

1. Subparagraph 1.1.9 - Other Definitions: Add the following new Subparagraph 1.1.9 as follows:

#### 1.1.9 OTHER DEFINITIONS

.1 "As required" shall mean as required by regulatory bodies, by referenced standards, by existing conditions, by generally accepted construction practice, or by the Contract Documents.

.2 "By Others" refers to work that is not part of the Contract.

.3 "By Owner" refers to work that will be performed by Owner or Owner's agents at Owner's cost.

.4 "Equal", "accepted equal", and "approved equal" shall mean as accepted, in writing, by Architect as being of equivalent quality, utility, and appearance.

.5 "Furnish" means supply only, do not install.

.6 "Install" means install only, do not furnish.

.7 "Provide" means furnish and install.

2. Subparagraph 1.2.2: Add the following new wording to the end of Subparagraph 1.2.2:

Documents prepared by entities other than Architect or its consultants may be included with documents prepared by Architect or its consultants for convenience in pricing, bidding, permit application, construction or other purposes. The inclusion of such documents not prepared by the Architect or its consultants within the Contract Documents shall not imply that Architect has reviewed, approved or is responsible for the accuracy or completeness of such documents.

3. Paragraph 1.5 - Ownership and Use of Drawings, Specifications and Other Instruments of Service: Add the following new subparagraph 1.5.3:

§1.5.3 In the event of any unauthorized use, reuse, transfer or modification of the Drawings, Specifications or other documents by Contractor, any lower tier contractor or material supplier, or other person or entity under Contractor's direct or indirect employ, Contractor agrees to indemnify, defend and hold Owner, Architect, their officers, directors, shareholders, employees, agents, and consultants harmless from and against any and all claims, liabilities, suits, demands, losses, damages, costs and expenses, including, but not limited to, reasonable attorneys' fees and all legal expenses and fees incurred through

appeal, and all interest thereon, accruing to or resulting from any and all persons, firms, or any other legal entities on account of any damages or losses to property or persons, including, but not limited to, injuries or death or economic losses arising out of such unauthorized use, reuse, transfer or modification, except where Architect is found to be solely liable as between the parties hereto as well as between any other persons, firms or other legal entities for such damages or losses by a court or forum of competent jurisdiction.

4. Subparagraph 1.6 - Transmission of Data in Digital Form: Add the following sentence at the end of Subparagraph 1.6

Any electronic transfer of Drawings, Specifications or other documents ("Data") by the Architect to the Contractor shall be subject to the terms of the Architect's standard Data Transfer Agreement, which shall be executed by the Contractor.

### ARTICLE 3 CONTRACTOR

5. Subparagraph 3.2.1: Add the following new sentence to the end of Subparagraph 3.2.1:

Additionally, Contractor acknowledges and agrees that the information contained in the Contract Documents is adequate and sufficient for completion of the Work.

6. Subparagraph 3.2.4: Revise the second sentence of Subparagraph 3.2.4 to read as follows:

If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, or reasonably should have recognized any errors, inconsistencies, omissions or nonconformity and failed to do so, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations.

7. Subparagraph 3.2.5: Add the following new Subparagraph 3.2.5:

**§3.2.5** In the event of conflicts or discrepancies among the Contract Documents, the following order of precedence shall govern: (1) Amendments and revisions (such as change orders), with those of later date taking precedence over those of earlier date; (2) the Agreement; (3) the Supplementary Conditions; (4) the General Conditions; (5) Drawings and Specifications. Drawings shall govern Specifications for quantity and location, and Specifications shall govern Drawings for quality and performance. In case of an inconsistency between Drawings and Specifications or within either Document not clarified by addendum, the better quality or greater quantity of Work shall be provided in accordance with the Architect's interpretation.

8. Subparagraph 3.4.2: Add the following new text to the end of Subparagraph 3.4.2:

Any requests for substitution shall be made in a timely manner and in full compliance with all Contract requirements. By making a request for substitution, Contractor: (1) represents that the Contractor has investigated the proposed substitute product and determined that it is equal to or superior in all respects to that specified; (2) represents that the Contractor will provide the same warranty for the substitution that the Contractor would for that specified; (3) certifies that the cost data presented is complete and includes all related costs under this Contract except for the Architect's redesign costs, and waives all claims for additional costs related to the substitution which subsequently become apparent; and (4) will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be



complete in all respects.

9. Subparagraph 3.7.3: Modify Subparagraph 3.7.3 as follows:

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

10. Subparagraph 3.9.1: Add the following new text to the end of Subparagraph 3.9.1:

The superintendent shall be approved by Owner and shall not be replaced without Owner's prior approval. The superintendent shall be familiar with the job site, the Contract Documents, and all applicable rules, regulations and requirements of all authorities having jurisdiction over the Work or the site.

11. Subparagraph 3.10.1: Add the following to the end of Subparagraph 3.10.1:

Such schedule shall be a computer generated critical path method (CPM) schedule showing at a minimum: (1) the early and late start time for each major construction activity; (2) all "critical path" activities and their duration; (3) late order dates for all long lead time materials and equipment; and (4) critical Owner decision dates.

12. Subparagraph 3.10.4: Add the following new Subparagraph 3.10.4:

**§3.10.4** Failure of Contractor to submit or keep current the construction schedule and submittals schedule as required by the conditions of the Work, shall be grounds for withholding of payments due Contractor by Owner, until such schedules are provided.

13. Subparagraph 3.11: Modify the first sentence of Subparagraph 3.11 as follows:

The Contractor shall maintain at the site for the Owner one copy of the Drawings, Specifications, Addenda, Change Orders and other modifications, in good order and marked currently to indicate field changes and selections made during construction, and one copy of approved Shop Drawings, Product Data, Samples and similar required submittals, as well as one copy of the approved permit set.

14. Subparagraph 3.12.6: Add the following text to the end of Subparagraph 3.12.6:

Incomplete, uncoordinated or incorrect Shop Drawings and other submittals shall be returned to Contractor who shall be held responsible for all time delays and extra costs of review or handling by Architect or Owner, because of such submittals being incomplete, uncoordinated or incorrect.

15. Subparagraph 3.12.7: Modify Subparagraph 3.12.7 as follows:

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

16. Subparagraph 3.12.8: Modify Subparagraph 3.12.8 as follows:

**3.12.8** The Work shall be in accordance with ~~approved~~ Architect-reviewed submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's ~~approval~~ review of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect in writing of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect's ~~approval~~ review thereof. If more than one submittal review stamp (Architect's and one or more of its consultants' stamp) appears on a submittal, the most stringent action and notations thereon shall apply. Signature on a submittal review stamp by the Architect or a consultant does not imply that it has reviewed Work not within its professional discipline or scope of services.

17. Subparagraph 3.12.10: Modify the second to last sentence of Subparagraph 3.12.10 as follows:

Pursuant to this Subparagraph 3.12.10, the Architect will review, ~~approve~~ or take ~~other~~ appropriate action on submittals only for the limited purpose of checking for conformance with information given and the visual and aesthetic design concept expressed in the Contract Documents.

18. Subparagraph 3.18.1: Revise Subparagraph 3.18.1 as follows:

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

19. Paragraph 3.19: Add the following new Paragraph 3.19:

### **§3.19 DESIGN/BUILD**

**§3.19.1** If Contractor provides and/or retains its subcontractors or others to provide Design/Build Work for specified portions of the Project, Contractor shall be responsible directly to Owner for those portions of the Project, including but not limited to: (1) preparing engineering and other drawings and specifications for all components of the Design/Build portion(s) of the Work, (2) complying with Project requirements and space limitations, (3) coordinating and interfacing with other trades and consultants, and (4) obtaining approvals from authorities having jurisdiction over the Project. Contractor, its subcontractor(s) or their design professional(s) shall be the Professional(s) of Record for their portion(s) of the Design/Build Work.

**§3.19.2** Architect shall have no responsibility for the design, installation or performance of Design/Build portions of the Project including but not limited to reviewing such designs and/or Work and/or certifying

the payment applications for the same. Architect's services in connection with any Design/Build work shall be limited to checking such designs for general conformance to major space limitations and the visual and aesthetic design concept as expressed in the Contract Documents. Such checking by Architect of more than two proposals for the same Design/Build portion of the Project shall be compensated as Additional Services.

**§3.19.3** When the Contract Documents or authorities having jurisdiction over the Project require certificates or statements of performance characteristics of materials, systems or equipment, or professional seals, calculations, or other certificates or statements regarding such Design/Build portions of the Project, Owner will require Contractor to provide them, and Owner and Architect will be entitled to rely on them to establish that the designs, materials, systems, equipment and such Work will meet the performance criteria required by the Contract Documents.

#### **ARTICLE 4 ARCHITECT**

20. Subparagraph 4.2.2: In the first sentence of this Subparagraph 4.2.2, replace the words "appropriate to the stage of the construction, or as otherwise agreed with the Owner" with the words "necessary in the judgment of Architect or as otherwise agreed by Owner and Architect in writing".

21. Subparagraph 4.2.3: Add the following text to the end of Subparagraph 4.2.3:

Architect's duties shall not extend to the receipt, inspection and acceptance on behalf of Owner or Contractor of materials, furniture, furnishings and equipment at the time of their delivery to the premises or installation. Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of Architect in Architect's administration of the Contract for Construction, or by tests, inspections or approvals required or performed by persons other than Contractor. If Architect recommends procedures, either directly or by reference to standards or manufacturers' recommendations, Contractor shall adopt such recommendations as its own, or inform Architect if exception is taken to such procedures, and may utilize or propose alternative procedures that Contractor will warrant as fulfilling the intent of the Contract Documents.

22. Subparagraph 4.2.4: Add the following text to the end of Subparagraph 4.2.4:

Should any direct communications become necessary, copies of the communications shall be promptly forwarded to the proper party or parties as set forth in this Subparagraph 4.2.4.

23. Subparagraph 4.2.5: Modify Subparagraph 4.2.5 as follows:

**4.2.5** ~~Based on Architect's on-site evaluations and the data comprising of the Contractor's Applications for Payment, the Architect will review and certify, to the best of its knowledge, information and belief, the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the amounts due the Contractor is entitled to payment of the amount certified and will issue Certificates for Payment in such amounts.~~

24. Subparagraph 4.2.7: Modify the first sentence of Subparagraph 4.2.7 as follows:

Architect will review and ~~approve or take other~~ appropriate action upon, the Contractor's submittals required by the Contract Documents, such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the visual and aesthetic design

concept expressed in the Contract Documents.

## ARTICLE 8

## TIME

25. Subparagraph 8.3.1: Starting on the fourth line of Subparagraph 8.3.1, delete the words, "pending mediation and arbitration; or by other causes which the Architect determines may justify delay" and add the following text at the end of Subparagraph 8.3.1: "A time extension shall be Contractor's sole remedy and there shall be no compensation for any such delays other than those resulting from the active interference of Architect, Owner or their employees or agents."

## ARTICLE 9

## PAYMENTS AND COMPLETION

26. Subparagraph 9.4.2: Add the following text to the end of Subparagraph 9.4.2:

Further, Architect shall not be obligated to issue any Certificate for Payment covering work by Design/Build contractors or subcontractors, work by Owner's separate contractors, or other work for which Architect is not providing full services.

27. Subparagraph 9.5.1.8: Add the following new Subparagraph 9.5.1.8:

.8 rejection or non-acceptance of Work by any governmental agency having jurisdiction.

28. Subparagraph 9.6.4: Add the following text to the end of Subparagraph 9.6.4:

At the Owner's sole discretion, payments may be made by check jointly payable to Contractor, its Subcontractor or supplier, and any applicable labor union trust fund.

29. Subparagraph 9.8.1: Modify this Subparagraph 9.8.1 as follows:

**9.8.1** Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents and all required final inspections and permits have been obtained so that the Owner can occupy or utilize the Work for its intended use, subject only to completion of minor items (punch list).

30. Subparagraph 9.8.3: Add the following text to the end of Subparagraph 9.8.3:

If upon this subsequent inspection, Contractor has not yet completed the Work, and further field reviews by Architect are required, Contractor shall be responsible to Owner for any additional cost to Owner of further reviews by Architect.

31. Subparagraph 9.8.4: Add the following text to the end of Subparagraph 9.8.4:

In the absence of such certificate, the date of Substantial Completion shall be in accordance with Subparagraph 9.8.1.

32. Subparagraph 9.9.3: Add the following text to the end of Subparagraph 9.9.3:

, nor shall it start the guarantee or warranty period.

**ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY**

**§10.3 HAZARDOUS MATERIALS**

33. Subparagraph 10.3.1: Modify Subparagraph 10.3.1 as follows:

**§10.3.1** The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials, including but not limited to asbestos or polychlorinated biphenyl (PCB) , lead-based paints or any other potentially toxic or hazardous contaminants, materials, pollutants which for the purpose of this Article 10 means solid, liquid, gaseous, or thermal irritant or contaminant, including smoke, vapor, soot, fumes, acids, alkalis, chemicals and wastes. Prior to commencement of the Work, Contractor shall require manufacturers of all materials and equipment for the Work to provide certifications, warranties or statements that such materials or equipment (1) are free of injurious amounts of hazardous materials or (2) contains specific amounts of hazardous materials, and provide recommendations regarding handling of such. Such certifications, warranties or statements shall be in writing in a form acceptable to Owner, and shall be forwarded by Contractor to Owner. If the manufacturer states that a material or equipment contains injurious amounts of hazardous materials, Owner shall be afforded adequate and timely opportunity to order that other materials be substituted without causing delay to the Project. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Owner and Architect in writing.

34. Subparagraph 10.3.6: Modify Subparagraph 10.3.6 as follows:

**§10.3.6** If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall indemnify the Contractor for all cost and expense thereby incurred, provided the Contractor has complied fully with its obligations under Subparagraph 10.3.1.

**ARTICLE 11 INSURANCE AND BONDS**

35. Subparagraph 11.1.5: Add the following new Subparagraph 11.1.5:

**§11.1.5** If Contractor fails to secure and maintain the required insurance, Owner shall have the right (but not the obligation) to secure same in the name and for the account of Contractor, in which event Contractor shall pay the cost thereof and shall furnish upon demand all information that may be required in connection therewith.

36. Subparagraph 11.3.1.4: Add the following text to the end of this Subparagraph 11.3.1.4:

It shall not, however, cover Contractor's equipment, machinery or tools.

37. Subparagraph 11.3.3: Add the following text to the end of Subparagraph 11.3.3:

, to the extent Owner's insurance covers such losses.

**ARTICLE 12 UNCOVERING AND CORRECTION OF WORK**

38. Subparagraph 12.1.1: Modify Subparagraph 12.1.1 as follows:

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

**END OF DOCUMENT 00 73 00**

## **SECTION 01 10 00 - SUMMARY**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
1. Project information.
  2. Work covered by Contract Documents.
  3. Work under separate contracts.
  4. Owner-furnished, Contractor-installed products.
  5. Specification and drawing conventions.
  6. Miscellaneous provisions.

#### **1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to the Work of all Sections in the Specifications. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all.
- B. Conflicts or discrepancies among the Contract Documents shall be resolved in the following order of priority:
1. Contract modifications (such as Change Orders and Bulletins) of later date take precedence over those of earlier date;
  2. the Agreement;
  3. Addenda of later date take precedence over those of earlier date;
  4. the Supplementary Conditions;
  5. The General Conditions;
  6. Drawings and Specifications; Drawings govern Specifications for quantity and location. Specifications govern Drawings for quality and performance. In the event of ambiguity or conflicts, the greater quantity and the better quality shall govern.

#### **1.3 PROJECT INFORMATION**

- A. Project Identification: Construction Trades II classroom/shop building, Long Beach City College (Pacific Coast Campus) .
1. Project Location: 1305 East Pacific Coast Highway, Long Beach, California.
- B. Owner: Long Beach City College (LBCC).

#### **1.4 WORK COVERED BY CONTRACT DOCUMENTS**

- A. The Project is defined by the Contract Documents and consists of a new single story classroom and shop building with lab/lecture classrooms, maker space area, offices and support spaces. Work also includes demolition of an existing building on the site..
1. The Work includes demolition, concrete work, structural steel and cold-formed metal framing, roofing and waterproofing, aluminum storefront and window wall systems, glazing, doors, frames and hardware, cement plaster and metal wall panel cladding, non-structural metal framing and drywall, interior finish work, miscellaneous building specialties, fire protection, plumbing, HVAC, electrical and low voltage systems, site improvements, and incidental related work .
- B. Type of Contract:
1. Project will be constructed under a single prime contract.

#### **1.5 WORK UNDER SEPARATE CONTRACTS**

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.
- B. Preceding Work: Owner will award separate contract(s) for the following construction operations at Project site. Those operations are scheduled to be substantially complete before work under this Contract begins.
1. Hazardous materials removal at Center and East Wings of Building MM.

#### **1.6 OWNER-FURNISHED, CONTRACTOR-INSTALLED PRODUCTS**

- A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.
1. Owner will arrange for and deliver Shop Drawings, Product Data, and Samples to Contractor.
  2. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.
  3. After delivery, Owner will inspect delivered items for damage. Contractor shall be present for and assist in Owner's inspection.
  4. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.
  5. Owner will arrange for manufacturer's field services and for delivery of manufacturer's warranties to Contractor.



6. Owner will furnish Contractor the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.
7. Contractor shall review Shop Drawings, Product Data, and Samples and return them noting discrepancies or anticipated problems in use of product. Examples of discrepancies or problems include, but are not limited to, coordination issues.
8. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.

B. Owner-Furnished Products:

1. Membrane roofing materials, as specified in Section 07 55 20 "Modified Bituminous Membrane Roofing."
2. Other products and equipment as indicated on Drawings.

## 1.7 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

## 1.8 MISCELLANEOUS PROVISIONS

A. Special Insurance: Contractor's Commercial General Liability insurance shall contain no exclusion that would deny coverage for any claim arising out of or contributed to by any fungus, mildew, mold, or resulting allergens. If such exclusion exists and cannot be removed by endorsement, Contractor shall submit proof of coverage for fungus, mildew, mold, or resulting allergens under a Pollution Legal Liability or Contractor's Pollution Liability policy.

**Gensler**  
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January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION**

## SECTION 01 13 00 - DELEGATED DESIGN REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for specific assemblies and other portions of the Work requiring design services performed by the Contractor.

#### 1.2 REFERENCES

- A. Abbreviations and Acronyms:
  - 1. DSA: Division of the State Architect (California).

#### 1.3 DEFINITIONS

- A. Delegated: For purposes of these specifications, "Delegated" is defined as the Architect transferring responsibility for specific design services to the Contractor.
- B. Design: Means the complete planning, arrangement, and coordination of a discrete portion of the work, along with its graphic and written communication, including determination and engineering of its organization and structure in response to aesthetic requirements, functional requirements, dimensional and geometric limits, and the arrangement, performance, and other criterion indicated in the Contract Documents, performed by professional engineers engaged by the Contractor..
- C. Engineering Services: Means structural engineering services performed for the design, fabrication, and installation of systems, assemblies, and components similar in material, design, complexity and extent to that indicated for the delegated design portion of the Work.
- D. Deferred Submittals: Deferred Submittals are a type of Delegated Design activity addressing specific portions of the Work, which will be submitted to DSA for review following their approval and permitting of the Contract Documents.
  - 1. Specific assemblies or areas of Work designated as Deferred Submittals are identified on the Drawings.
  - 2. The Contract Documents indicate and describe "Design Intent" of the assemblies or areas of Work designated as Deferred Submittals; final engineering design is the responsibility of the Contractor.
  - 3. Deferred Submittal documentation, prepared by the Contractor, will be reviewed by the Architect and Architect's consultants prior to submittal to the AHJ for review.

- a. Architect and consultants' review of Deferred Submittal documentation is for the limited purpose of checking for general conformance to the design concept expressed in the Contract Documents, and that the criteria expressed in the Contract Documents were used in the design.
- b. Contractor is responsible for coordinating and facilitating preparation of Deferred Submittal documentation in a timely manner, to ensure sufficient time for Architect and consultants' review prior to submitting Deferred Submittal packages to the AHJ. Failure to do so will not justify delays or extensions of time.
- c. Contractor is advised that Authority Having Jurisdiction may require additional Deferred Submittals at its discretion during the plan review process. Verify final listing of Deferred Submittal items on approved Drawings.

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Portions of the Contract Documents may delegate the design of specific assemblies and discrete portions of the Work to the Contractor; where required, "Delegated Design" requirements, including performance criteria, submittal requirements, and other requirements, are described in individual specification Sections.
  1. The Contractor is professionally liable for delegated design work, including design, engineering, and conformance to specified performance requirements.
  2. Delegated Design work is not limited to those specific areas of work or assemblies designated as "Deferred Submittals." Where individual specification Sections include Delegated Design, the engineering services necessary to perform the work are a Contract requirement, unless otherwise directed in writing by the Architect.
- B. Drawings of delegated design portions of the Work are diagrammatic; they do not identify or imply solutions to engineering aspects of the portions of the Work that are required to be designed by the Contractor, and are intended to only indicate the following:
  1. The design intent of final profiles, shapes and forms of the specified materials.
  2. Relationships between adjacent components of the Work.
  3. Location, identification, dimension and size of components, assemblies, accessories, and other components of the Work.
  4. Schematic joining and attachment details and diagrams of fasteners and connections.
- C. Specifications for delegated design portions of the Work are performance based, and establish the minimum qualities and performance criteria for materials, fabrications, products, systems, assemblies, and methods of execution.
  1. Within individual Divisions 02-34 specification Sections, Delegated Design requirements are typically described as follows:
    - a. Delegated Design/Deferred Submittal Requirements: Typically in Part 1 "Submittals" Article.
    - b. Engineer Qualifications: Typically in Part 1 "Quality Assurance" Article.
    - c. Design Loads and Related Engineering and Design Criteria: Typically in Part 2 "Performance Requirements" Article.

- D. The Architect reviews and determines whether or not the Contractor's proposed delegated designed work conforms to the following:
  - 1. The design intent of the delegated design portion of the Work being reviewed.
  - 2. Graphic and specification requirements, including subsequent modifications.
  - 3. Work is appropriately integrated into the adjacent components of the Work and, where applicable, the overall design of the project.
- E. In the event of a dispute regarding the Contractor's proposed delegated design solutions and the design intent of the Contract Documents, the decision of the Architect is final.

## 1.5 PROCEDURAL REQUIREMENTS

- A. Design Requirements: Proposed delegated design solutions shall demonstrate conformance to the original design intent of the Contract Documents, as determined by the Architect.
  - 1. Unless otherwise defined by the Contract Documents, the appearance of exposed elements, including member sizes, profiles, and alignment of components shall be within the dimensional limits and section profiles indicated, and consistent throughout the Project where the delegated design component of the Work is to be installed.
  - 2. Deviation from the profiles, layouts, dimensional locations, or arrangements indicated is not permitted without prior written consent from the Architect.
  - 3. Deviations from the specifications are not permitted without prior written consent from the Architect.
  - 4. Contractor-proposed delegated design solutions that exactly follow the details indicated on the Drawings do not relieve the Contractor from liability for the engineering design, fabrication, and performance of the delegated design portions of the Work.
- B. Engineering Requirements: Engineering of delegated design portions of the Work shall comply with the following:
  - 1. Meet or exceed the specified performance performance and quality requirements.
  - 2. Conform to the dimensional and graphic requirements of the Drawings.
  - 3. Satisfy the requirements of the DSA.
  - 4. Provide structurally sound, leak-proof, non-corroding, and weather tight assemblies, as applicable, that accommodate, resist, distribute, or transfer, as applicable, the minimum specified in-service loads, and thermal, seismic, and wind sway, or other types of movement, without incipient or catastrophic failure.
- C. Regulatory Requirements: Delegated design items shall be engineered in conformance with the California Building Code.

## 1.6 SUBMITTALS

- A. General: Coordinate and process submittals for delegated design portions of Work in same manner as for other portions of Work.

1. Architect and consultants will review and respond to Delegated Design submittals as "Action Submittals" or "Informational Submittals," in accordance with the requirements of individual specification Sections and Section 01 33 00.
  2. Where Deferred Submittals are indicated on Drawings, coordinate preparation and processing to ensure timely submission to the AHJ for review.
- B. Schedule of Delegated Design Items: Submit a schedule listing all Delegated Design items, arranged per the Project Manual Table of Contents, within 30 days of the Notice to Proceed. Include the following for each item:
1. Description of assembly or area of work.
  2. List of documentation (Shop Drawings, calculations, other engineering analysis).
  3. Name of Professional Engineer.
  4. Indicate whether the assembly or area of work is a Deferred Submittal requiring AHJ review.
- C. Submit Professional Engineer's qualifications and other certifications as required in individual Division 02-33 specification Sections.
- D. Design Data: Submit structural engineering calculations demonstrating conformance to the requirements of the Contract Documents and of the DSA .
1. Calculations must be legible and incorporate sufficient cross-references to shop drawings to make calculations readily understandable and reviewable.
  2. At a minimum, structural calculations must contain:
    - a. An analysis of framing members.
    - b. Section property computations for framing members.
    - c. An analysis of anchors, including anchors embedded in concrete.
    - d. The signature and seal of the professional structural engineer, licensed in the state of California, and responsible for their preparation.
  3. Test reports are not an acceptable substitute for calculations.

## 1.7 QUALITY ASSURANCE

- A. Professional Structural Engineer's Qualifications: Must be legally licensed or otherwise qualified to practice in the state of California. The engineer shall have not less than 10 consecutive years' experience providing engineering services for delegated design work similar in material, design, complexity, and extent to this Project, as determined by the Architect, and whose Work products have resulted in installations with a record of successful in-service performance.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Provide materials, fabrications, products, components, and accessories required for a complete installation, whether or not such items are indicated on the Drawings or in the Specifications.
- B. Provide anchors, attachments, inserts, fasteners, clips, bracing, framework, and similar items as required to meet specified design and performance requirements, and to securely attach delegated design Work to adjacent supports, or to adjoining work, whether or not such items are indicated on the Drawings or in the Specifications.

## **PART 3 - EXECUTION**

### **3.1 DESIGN**

- A. Unless otherwise indicated or specified, maintain the design intent and conform to the performance requirements indicated on the Drawings and in the Specifications, as determined by the Architect.
  - 1. In the interest of fabrication or erection methods, minor dimensional changes and detailing adjustments to the original design communicated in the Contract Documents may become necessary.
  - 2. Obtain written approval from the Architect for proposed changes and adjustments before procurement, fabrication, manufacture, assembly, or installation, as applicable.
- B. Engage a qualified professional structural engineer to design connection details and determine fastener types and sizes.
  - 1. Fasteners or connections may neither conflict with nor require revision to the finish profiles indicated or the supporting work.
  - 2. Connections may not impose eccentric loading, nor induce twisting or warping to the supporting structure.
  - 3. Connections must be designed to accommodate potential and actual misalignment of adjacent work within tolerances specified in other Sections.

### **3.2 DEFERRED SUBMITTAL SCHEDULE**

- A. Assemblies and areas of Work designated as "Deferred Submittals" are indicated on Drawings.

### **3.3 DELEGATED DESIGN SCHEDULE**

- A. Assemblies and areas of Work requiring delegated design are indicated in individual specification Sections. Refer to individual Division 02-33 specification Sections for design criteria, submittal requirements, and professional qualification requirements for entities providing delegated design engineering services.

**END OF SECTION**



## **SECTION 01 14 00 - WORK RESTRICTIONS**

### **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. Existing utility interruptions.
  - 2. Use of premises.
  - 3. Occupancy requirements during construction.
  - 4. Occupancy requirements prior to Substantial Completion.
  - 5. Miscellaneous restrictions.

#### **1.3 EXISTING UTILITY INTERRUPTIONS**

- A. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
  - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
  - 2. Obtain Owner's written permission before proceeding with utility interruptions.

#### **1.4 USE OF PREMISES**

- A. Access: At all times, provide the Architect and the Owner's representatives, easy and safe access to the Work wherever it is in preparation and progress. Provide such access so Architect may perform its functions. Provide access to any testing agencies to perform required testing.
- B. Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- C. Use of Site: Confine operations at the site to areas permitted by law, ordinances, permits, and the Contract Documents. Do not unreasonably encumber the Site with any materials or equipment. Coordinate loading on floor or roof with Architect and/or Structural Engineer to assure that no surfaces exceed carrying capacity.

1. Protect and maintain common areas of the building that are in the path of travel for construction personnel and used for transporting materials and equipment to and from the construction site.
  2. Limits: Confine constructions operations to areas indicated on Drawings.
  3. Driveways and Entrances: Keep driveways loading areas, and entrances serving premises clear and available to Owner, Owner's employees, students, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
    - a. Schedule deliveries to minimize use of driveways and entrances.
    - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
  4. Do not block entrances, fire exits or lanes, or delivery routes.
  5. Limit use of driveways and entrances to the following times:
    - a. Monday through Friday: 9 AM to 4 PM.
    - b. After Hours (When Approved by Owner : 7 PM to 10 PM, and anytime on Saturday.
- D. On-Site Work Hours: Limit work in the existing building to normal business working hours, Monday through Friday, unless otherwise indicated.
1. Hours for Noise-Generating, Odor-Generating, and Dust-Generating Activities and Demolition: After business hours, or at such times as approved by the Owner.
    - a. Noise- and Odor-Generating activities include, but are not limited to, sprinkler work, concrete saw cutting, core drilling, spray painting, hammering, nailing, and similar work, which may cause noise, dust, or odors, thereby disturbing occupants.

## 1.5 OCCUPANCY REQUIREMENTS DURING CONSTRUCTION

- A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
  2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.
  3. Schedule use of premises for Work and coordinate construction operations with the Owner to allow for Owner occupancy.
  4. Keep premises orderly, clean and with a minimum of obstruction and inconvenience to the tenants and the public.

5. Relocate any stored products that interfere with public access, operations of the Owner or separate contractor. If necessary, obtain and pay for additional storage or work areas needed for operations.

## **1.6 OCCUPANCY REQUIREMENTS PRIOR TO SUBSTANTIAL COMPLETION**

- A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.
  1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior Owner acceptance of the completed Work.
  2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
  3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will provide, operate, and maintain mechanical and electrical systems serving occupied portions of Work.
  4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

## **1.7 MISCELLANEOUS RESTRICTIONS**

- A. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
  1. Notify Owner not less than two days in advance of proposed disruptive operations.
  2. Obtain Owner's written permission before proceeding with disruptive operations.
- B. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.
- C. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.
- D. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- E. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
  1. Maintain list of approved screened personnel with Owner's representative.

**Gensler**  
005.2882.000

January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION**

## SECTION 011216 – PHASING OF THE WORK

### PART 1 – GENERAL

#### 1.01 SECTION INCLUDES

- A. Requirements for phasing of the Work include logistics, phasing, and completion of designated phases prior to commencement of subsequent phases.

#### 1.02 RELATED SECTIONS

- A. Section 011100: Summary of Work
- B. Section 013100: Project Management and Coordination
- C. Section 013210: Construction Schedule
- D. Section 013300: Submittal Procedures
- E. Section 015000: Construction Facilities and Temporary Controls
- F. Section 017700: Closeout Procedures
- B.

#### 1.03 SUBMITTALS

- A. Contractor shall submit a Project site logistics plans in accordance with and as required by this Section.

### PART 2 – PRODUCTS (NOT APPLICABLE)

### PART 3 – EXECUTION

#### 3.01 LOGISTICS

- A. Prior to commencement of the Work, Contractor shall prepare and submit, through Procore, to the District Representative, a detailed Project site logistic plan, in the same size and scale of the Drawings, setting forth Contractor plan of the Work relative to the following, but not limited to, items:
  - 1. In accordance with local ordinances a truck access route to and from the Project
  - 2. The identification of any overhead wire restrictions for power, street lighting, signal, and/or cable.
  - 3. Local sidewalk access and street closure requirements.
  - 4. Protection of sidewalk pedestrians and vehicular traffic.
  - 5. Project site fencing and access gate locations.
  - 6. Construction parking.

7. Material staging and/or delivery areas.
  8. Material storage areas.
  9. Temporary trailer locations.
  10. Temporary service location and proposed routing of all temporary utilities.
  11. Location of temporary and/or accessible fire protection.
  12. Trash removal and location of dumpsters.
  13. Concrete pumping locations.
  14. Crane locations.
  15. Location of portable sanitary facilities.
  16. Mixer truck wash out locations.
  17. Traffic control signage.
  18. Perimeter and site lighting.
  19. Stockpile and/or lay down areas.
  20. Emergency Vehicle Access Routes
- B. A revised Project site logistic plan may be required by the District Representative for separately identified phases of file Work as set forth in this Section.
- C. Contractor is responsible for securing and/or obtaining all approvals and permits from authorities having jurisdiction relative to logistic plan activities.

### 3.02 PHASING OF THE WORK:

- A. Project will be constructed in separate Milestone increments, as identified or as described in this Section and/or the Contract Documents. Phasing will also delineate Work to be completed in each designated phase. Unless otherwise approved or directed by the District Representative, each phase shall be completed according to the approved Construction Schedule prior to the commencement of the next subsequent phase. Contractor shall incorporate and coordinate the Work of Separate Work Contracts relative to this Project into the Phasing and Construction Schedule.
- B. Contractor shall install all necessary Work for phased Work before completion of the designated phase.

### 3.03 PHASING OF THE WORK – GENERAL:

- A. Contractor shall prepare the Milestone Schedule in order to complete the Work and related activities in accordance with the phasing plan. Contractor shall include all costs to complete all Work within the Milestones and/or Contract Time.
- B. Owner will be seriously damaged by not having all Work completed within the Milestones and/or Contract Time. It is mandatory the Work be complete within the Milestones and/or Contract Contractor shall install all necessary Work for phased Work before completion of the designated phase.

END OF SECTION 011216

## **SECTION 01 23 00 - ALTERNATES**

### **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 and procedural requirements for alternates.

#### **1.3 DEFINITIONS**

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
  - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
  - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

#### **1.4 PROCEDURES**

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
  - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.

- D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

## **PART 2 - PRODUCTS (Not Used)**

## **PART 3 - EXECUTION**

### **3.1 SCHEDULE OF ALTERNATES**

- A. No. 1: Countertops.
1. Base Bid: Provide solid surface countertops where indicated.
  2. Alternate: Provide plastic laminate countertops with PVC edge band, PL-02, in lieu of solid surface tops in all rooms except MM 108, 109, and 126.
- B. No. 2: Storage Room MM130 Casework.
1. Base Bid: Provide casework in Room MM130 as indicated on Drawings.
  2. Alternate: Omit casework in Room MM130.
- C. No. 3: Canopy Sunshade Panels at north elevation of South building.
1. Base Bid: Provide louver infill panels at canopy as indicated on Drawings and as specified in Section 05 70 00.
  2. Alternate: Omit louvered infill panels only. Provide perimeter framing and solid infill per original design.
- D. No. 4: Sunshade Panels at south elevation of South building.
1. Base Bid: Provide louver infill at canopy as indicated on Drawings and as specified in Section 05 70 00.
  2. Alternate: Remove opening and replace with continuation of roof/soffit framing, typical roofing assembly R1, and cement plaster soffit S1.
- E. No. 5: Glazed Sectional Doors.
1. Base Bid: Provide glazed sectional doors type D as indicated on Drawings and as specified in Section 08 36 13 "Sectional Doors."
  2. Alternate: Provide aluminum storefront, double swing doors, type B2, in lieu of sectional doors (6-foot, 6-inch opening).



- F. No. 6: Fire-resistive Window Assembly (Storage 3/Arch 4).
1. Base Bid: Provide fire-resistive window assembly between Storage MM128 and Arch 4 MM129 as indicated on Drawings.
  2. Alternate: Omit window opening at this location and replace with continuation of designated partition.
- G. No. 7: Interior Storefront (Arch 2/Arch 3).
1. Base Bid: Provide STC 50-rated interior storefront assembly (Arcadia T500-UA) between Arch 2 (MM123) and Arch 3 (MM124), as indicated on Drawings.
  2. Alternate: Provide STC 40 interior storefront assembly (Arcadia TC 470) in this location, in lieu of STC 50 system indicated on Drawings.
- H. No. 8: Counter Door at Room 130C.
1. Base Bid: Provide overhead coiling counter door as indicated.
  2. Alternate: Omit door opening at this location and replace with continuation of designated partition.
- I. No. 9: Concrete Floor Finish:
1. Base Bid: Provide polished concrete floor finish where indicated.
  2. Alternate: Replace polished finish with linoleum flooring as specified in Section 09 65 16.13 "Linoleum Flooring."
- J. No. 10: Wall Graphic at Office.
1. Base Bid: Vinyl film graphic as indicated on Drawings and as specified in Section 10 14 23 "Panel Signage."
  2. Alternate: Omit vinyl graphic; provide paint to match adjacent wall surface.
- K. No. 11: Integrally Colored Cement Plaster.
1. Base Bid: Provide integral color cement plaster as specified in Section 09 24 00.
  2. Alternate: Omit integral color; provide plaster finish coat suitable for field painting and paint to match EP-01.
- L. No. 12: Interior/Exterior Painted Wall Graphic along west wall of MM101 and south wall of North building.
1. Base Bid: Provide painted wall graphic as indicated on Drawings and specified in Section 10 14 73.

2. Alternate: Omit wall graphic; provide EP-01 wall finish.

M. No. 13: Site Fencing Type.

1. Base Bid: Provide decorative welded wire steel fencing and gates per drawings at locations indicated.
2. Alternate Option 1: Provide chain link fencing in lieu of welded wire fencing at west side of outdoor Architectural Yard only; provide decorative welded wire steel fencing and gates at other locations. See alternate details in Landscape drawings.
3. Alternate Option 2: Provide chain link fencing in lieu of welded wire fencing at east and west sides of outdoor Architectural Yard only; provide decorative welded wire steel fencing and gates at other locations. See alternate details in Landscape drawings.
4. Alternate Option 3: Provide fencing in Alternate Option 2 configuration, plus provide chain link fencing at fence/gate between south wing and existing west wing of Building MM; provide decorative welded wire steel fencing and gates at other locations. See alternate details in Landscape drawings.

N. No. 14: Site Fencing Height.

1. Base Bid: Provide decorative welded wire steel fencing and gates at locations indicated.
2. Alternate: Reduce fence and gate height in all locations by 2-feet.

O. No. 15: Site Furnishings.

1. Base Bid: Provide all site furnishings indicated on landscape Drawings, except S2 (Specialty Bench).
2. Alternate: Omit site furnishings S3 (Standard Bench), S4 (Stool), and S7 (Rainwater Barrel).

P. No. 16: Dust Collection System.

1. Base Bid: Provide dust collection system as indicated on mechanical Drawings and specified in Section 44 11 16.
2. Alternate: Omit dust collection system and installation of CNC machine.

Q. No. 17: Reduce Planting Sizes.

1. Base Bid: Provide 36-inch diameter box trees; provide 15-gallon Agave.
2. Alternate: Provide 24-inch diameter box trees; provide 5-gallon Agave.

R. No. 18: Dewpoint Sensors.

1. Base Bid: Provide dewpoint sensors at AHU supply ducts, as indicated.
  2. Alternate: Omit dewpoint sensors at AHU supply ducts.
- S. No. 19: Low Static/High Static Limit Switches.
1. Base Bid: Provide low static and high static limit switches at AHU supply and return fans.
  2. Alternate: Omit low static and high static limit switches at AHU supply and return fans.
- T. No. 20: Airflow Measuring Stations; AHU Supply and Return Fans.
1. Base Bid: Provide airflow measuring stations at AHU supply and return fans.
  2. Alternate: Omit airflow measuring stations at AHU supply and return fans.
- U. No. 21: Airflow Measuring Stations; AHU Outside Air Intakes.
1. Base Bid: Provide airflow measuring stations at outside air intakes, at AHU-2 through AHU-7.
  2. Alternate: Omit airflow measuring stations at outside air intakes, at AHU-2 through AHU-7.
- V. No. 22: CHWR Temperature Sensors, AHU Coils.
1. Base Bid: Provide CHWR temperature sensors at AHU coils.
  2. Alternate: Omit CHWR temperature sensors, at AHU coils.
- W. No. 23: Copper/Aluminum Feeders.
1. Base Bid: Provide feeders as specified.
  2. Alternate: Provide aluminum feeders for feeder size #2/0 AWG size feeders and larger; provide copper feeders at feeder sizes smaller than #2/0 AWG.
- X. No. 24: Aluminum Bussing.
1. Base Bid: Provide electrical bussing as specified.
  2. Alternate: Provide aluminum bussing for panelboards, switchboards, and transformers.
- Y. No. 25: Data Drops/Convenience Outlets.
1. Base Bid: Provide data drops where indicated on Drawings.

**ADDENDUM 3 RFI 28**

48. Q: For bid alternate item #23 aluminum feeder wire deduct, can you confirm it is for providing aluminum feeder wire in lieu of copper with same amperage capacity but also adding hypress pigtail adapters for the aluminum wire?

A: That is correct. Substitute copper wires larger than #2/0 with equivalent aluminum feeders with associated conduit size increase if needed. Hypress pigtail adapters are not required if lugs are UL listed to accept aluminum wire. Provide antioxidant paste to aluminum terminations.

2. Alternate: Reduce data drop quantities to match typical classroom guidelines in District standards, in Classrooms MM102, 103, 119, 120, 121, and 122 by providing the following:
    - a. One data outlet per wall (District standard).
    - b. Two convenience power outlets on back wall.
    - c. One convenience outlet per wall on remaining 3 walls.
- Z. No. 26: Roller Shades.
1. Base Bid: Where roller shades are indicated on Drawings, provide single roller assemblies with light filtering fabric as scheduled on Drawings and specified in Section 12 24 13.
  2. Alternate: Provide double roller assemblies with light blocking fabric (Mecho Distinctive Blackout 0800 series, color TBD) at spaces with digital display screens (MM101, 102, 103, 110, 119, 120, 121, 122, 123, 124).
- AA. No. 27: Site Furnishings S2 through S5.
1. Base Bid: Provide site furnishings indicated on landscape Drawings, except S2 (Specialty Bench).
  2. Alternate: Provide all site furnishings indicated on landscape Drawings
- BB. No. 28: Increase Planting Sizes.
1. Base Bid: Provide 36-inch diameter box trees.
  2. Alternate: Provide 48-inch diameter box trees.
- CC. No. 29: CHW Piping Insulation.
1. Base Bid: Provide phenolic piping insulation at outdoor CHW piping only.
  2. Alternate: Provide phenolic piping insulation at all CHW piping.
- DD. No. 30: Warranty Period.
1. Base Bid: Provide warranty period of one year per Contract Documents.
  2. Alternate: Extend warranty period by one year, for a total of 2 years.

**END OF SECTION**

## **SECTION 01 25 00 - SUBSTITUTION PROCEDURES**

### **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 and procedural requirements for substitutions.
- B. Related Sections:
  - 1. Section 01 60 00 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
  - 2. Divisions 02 through 49 Sections for specific requirements and limitations for substitutions.

#### **1.3 DEFINITIONS**

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

#### **1.4 ACTION SUBMITTALS**

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use facsimile of "Substitution Request" form provided in Document 00 60 00 "Forms."
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

- a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
  - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, necessary to accommodate proposed substitution.
  - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
  - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
  - e. Samples, where applicable or requested.
  - f. Certificates and qualification data, where applicable or requested.
  - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
  - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
  - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES and local regulations.
  - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - k. Cost information, including a proposal of change, if any, in the Contract Sum.
  - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
  - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. In most cases, Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Bulletin for minor changes in the Work.
  - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

## 1.5 QUALITY ASSURANCE

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

## 1.6 PROCEDURES

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

## PART 2 - PRODUCTS

### 2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately upon discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
  - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - b. Requested substitution provides sustainable design characteristics that specified product provided .
    - c. Substitution request is fully documented and properly submitted.
    - d. Requested substitution will not adversely affect Contractor's construction schedule.
    - e. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - f. Requested substitution is compatible with other portions of the Work.
    - g. Requested substitution has been coordinated with other portions of the Work.
    - h. Requested substitution provides specified warranty.
    - i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
  - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
  - b. Requested substitution does not require extensive revisions to the Contract Documents.
  - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  - d. Requested substitution provides sustainable design characteristics that specified product provided.
  - e. Substitution request is fully documented and properly submitted.
  - f. Requested substitution will not adversely affect Contractor's construction schedule.
  - g. Requested substitution has received necessary approvals of authorities having jurisdiction.
  - h. Requested substitution is compatible with other portions of the Work.
  - i. Requested substitution has been coordinated with other portions of the Work.
  - j. Requested substitution provides specified warranty.
  - k. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION**



## SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Sections:
  - 1. Division 1 Section "Section 012500 - Substitution Procedures" for administrative procedures for handling requests for substitutions made after Contract award.

#### 1.3 ADDENDA

- A. Addenda shall be signed by Architect and approved by DSA.

#### 1.4 MINOR CHANGES IN THE WORK

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

#### 1.5 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: BMT will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. Request will be generated, and must be responded to, within Procore. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Proposal Requests issued by BMT are not instructions either to stop work in progress or to execute the proposed change.
  - 2. **Within 10 days**, unless indicated otherwise, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the

Contract Time necessary to execute the change. Refer to the General Conditions for additional requirements.

- a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
  - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
  - c. Include costs of labor and supervision directly attributable to the change.
  - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
  - e. Quotation Form: Use CSI Form 13.6B "Proposal Worksheet Summary" and 13.6C "Proposal Worksheet Detail" or Contractor's comparable forms.
- B. Contractor Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to the BMT and Architect.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
  2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
  3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
  4. Include costs of labor and supervision directly attributable to the change.
  5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
  6. Comply with requirements in Division 1 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
  7. Proposal Request Form: Use CSI Form 13.6A "Change Order Request (Proposal)" with attachments CSI Form 13.6B "Proposal Worksheet Summary" and 13.6C "Proposal Worksheet Detail" or Contractor's comparable forms.

## 1.6 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: Refer to Division 1 Section "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

## 1.7 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, the BMT will issue a Change Order, through Procore, for signatures of Owner, Architect, and Contractor.
  - 1. Change Orders shall be signed by the Architect, Contractor, Owner and BMT.
  - 2. Previous change orders and change order execution status can be viewed within Procore

## 1.8 CONSTRUCTION CHANGE DIRECTIVE

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

**SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES**

**SUPERSEDE - REPLACED**

**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 and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
  - 1. Section 01 25 00 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

**1.3 PROPOSAL REQUESTS**

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Bulletins with "Architect's Request for Contractor's Proposal" indicated, issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
  - 2. Within time specified in Bulletin after receipt of Bulletin, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include costs of labor and supervision directly attributable to the change.
    - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
    - e. Quotation Form: Use forms acceptable to Architect.

- B. Contractor-Initiated Proposals (Change Order Request): If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
  2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
  3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
  4. Include costs of labor and supervision directly attributable to the change.
  5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
  6. Comply with requirements in Section 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
  7. Proposal Request Form: Use form acceptable to Architect.

#### **1.4 ADMINISTRATIVE CHANGE ORDERS**

- A. Allowance Adjustment: See Section 01 21 00 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Unit-Price Adjustment: See Section 01 22 00 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

#### **1.5 CHANGE ORDER PROCEDURES**

- A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on Gensler "Change Order" form included in Document 00 60 00 "Forms."

#### **1.6 CONSTRUCTION CHANGE DIRECTIVE**

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION**

## **SECTION 01 26 13 - REQUESTS FOR INTERPRETATION (RFI)**

### **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 and procedural requirements for handling and processing Requests for Interpretation.

#### **1.3 DEFINITIONS**

- A. Requests for Interpretation (RFI): Contractor initiated written instrument related to the execution of the Work that is addressed to the Architect. The RFI shall be used by the Contractor as the means to ask questions related to the Work; subject to the conditions contained within this Section.

#### **1.4 ACTION SUBMITTALS**

- A. Requests for Interpretation: Include a detailed, legible description of an item needing information or interpretation and the following:
  - 1. Project name.
  - 2. Project number.
  - 3. Date.
  - 4. Name of Contractor.
  - 5. Name of Architect.
  - 6. RFI number, numbered sequentially.
  - 7. RFI subject.
  - 8. Reference to appropriate documents:
    - a. Specification Section number and title and related paragraphs.
    - b. Drawing number and detail references.
    - c. Schedule.
    - d. Bulletin number.
    - e. Other Contract Documents, if any.
  - 9. Field dimensions and conditions, as appropriate.
  - 10. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.

11. Contractor's and RFI Manager's signature.
12. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
  - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- B. RFI Forms: Use "Request for Interpretation" form bound in Document 00 60 00 "Project Forms."
  1. Attachments shall be electronic files in Adobe Acrobat PDF format.

### **1.5 INFORMATIONAL SUBMITTALS**

- A. RFI Log: Prepare, maintain, and submit a tabular log of RFI organized by the RFI number. Submit log weekly. Include the following:
  1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Architect.
  4. RFI number including RFIs that were returned without action or withdrawn.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date Architect's response was received.

### **1.6 QUALITY ASSURANCE**

- A. Authorship: Prior to the commencement of the RFI process, designate a full time "RFI Manager" whose duties shall include the responsibility for enforcing the Request for Interpretation provisions of this Section, to maintain an up-to-date log of all RFI, advise the Architect, in writing, of the status and disposition of all RFI at the progress meetings, and be a member of the Contractor's staff. The RFI Manager shall be experienced in administration and supervision of the type of Work indicated on the Contract Documents.
  1. RFI Manager may be the Contractor's Job Superintendent.
  2. Each RFI shall originate solely from the RFI Manager. An RFI submitted to the Architect by an entity, or individual, other than the RFI Manager shall be returned to the Contractor.

### **1.7 ADMINISTRATIVE REQUIREMENTS**

- A. Processing Time: In most cases, allow five working days for Architect's response for each RFI. RFI received by Architect after 3:00 p.m. will be considered as received the following business day.



1. Allow additional time if coordination with other work is required. Architect will advise Contractor when a RFI being processed must be delayed for coordination.
  2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
- B. Architect's action on RFI that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Proposal Request according to Section 01 26 00 "Contract Modification Procedures."
1. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- C. Frivolous RFI:
1. RFI shall not be used for the following:
    - a. Request for approval of submittals.
    - b. Request approval of substitutions.
    - c. Requests for approval of Contractor's means and methods.
    - d. Request for adjustment in the Contract Time or the Contract Sum.
    - e. Requests for interpretation of Architect's actions on submittals.
    - f. Requests for coordination information already indicated in the Contract Documents, or to transfer coordination responsibility from the Contractor to the Owner or Architect.
    - g. Incomplete RFI or inaccurately prepared RFI.
  2. The Owner reserves the right to assess the Contractor for the cost (based on time and materials) of a RFI response performed by the Architect, and any of its consultants, which is deemed by the Owner and the Architect as being frivolous or unnecessary.
  3. Frivolous RFI shall be removed from the RFI log.

## 1.8 COORDINATION

- A. Coordination: Coordinate preparation and processing of RFI with performance of construction activities.
1. Submit RFI with such promptness as to cause no delays in the Work. No adjustments of Contract Time or Contract Sum will be granted because of failure to have an RFI submitted with sufficient time to allow for the orderly processing of a response by the Architect.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION**

**3.1 CONTRACTOR'S ACTION**

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, prepare and submit an RFI in the form specified.
- B. Prior to submission of the RFI, coordinate the nature of the inquiry with the requirements of other Sections or trades as related thereto and responses to previous RFI.
- C. Complete each blank on the RFI form.
- D. In preparing each RFI, verify the applicable dimension(s), field conditions, Drawing requirements (small through large scale details), and/or Specification Section requirements pertaining thereto.
- E. Each RFI shall be reviewed, and signed by the RFI Manager prior to transmitting to the Architect .
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

**3.2 ARCHITECT'S ACTION**

- A. Architect's Action: Architect will review each RFI, determine action required, and respond.
  - 1. Frivolous RFI will be returned without action.
- B. RFI which fail to conform to requirements, (for example, is incomplete or contain numerous errors) shall be returned to the Contractor without a response. No adjustments for Contract Time or Contract Sum shall be granted for an RFI failing to conform to requirements.

**END OF SECTION**

## SECTION 012900 - PAYMENT PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections:
  - 1. Division 1 Section "Allowances" for procedural requirements governing the handling and processing of allowances.
  - 2. Division 1 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
  - 3. Division 1 Section "Construction Schedule" for administrative requirements governing the preparation and submittal of Contractor's Contractor schedule.
  - 4. Division 1 Section "Submittal Procedures" for administrative requirements governing the preparation and submittal of submittal schedule.

#### 1.3 DEFINITIONS

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

#### 1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's Contractor schedule.
  - 1. Correlate line items in the schedule of values with other required administrative forms and schedules, including the following:
    - a. Application for Payment forms with continuation sheets.
    - b. Submittal schedule.
    - c. Schedule of Values submittal to be sent through the Procore

- d. Items required to be indicated as separate activities in Contractor's Contractor schedule.
  2. Submit the schedule of values to the BMT at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
  3. Sub-schedules for Phased Work: If at any time the Work is separated into phases requiring separately phased payments, provide sub-schedules showing values correlated with each phase of payment.
  4. Sub-schedules for Separate Elements of Work: Where the Contractor's Contractor schedule defines separate elements of the Work; provide sub-schedules showing values correlated with each element.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the schedule of values:
    - a. Project name and location.
    - b. Name of Architect.
    - c. Name of IOR.
    - d. Name of BMT.
    - e. Project Number.
    - f. Contractor's name and address.
    - g. Date of submittal.
  2. Arrange schedule of values consistent with format of AIA Document G703.
  3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
    - a. Related Specification Section or Division.
    - b. Description of the Work.
    - c. Name of subcontractor.
    - d. Name of manufacturer or fabricator.
    - e. Name of supplier.
    - f. Change Orders (numbers) that affect value.
    - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
      - 1) Labor.
      - 2) Materials.
      - 3) Equipment.
  4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of Contract Sum.

- a. Include separate line items under Contractor and principal subcontracts for project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
  - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
9. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
10. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
  - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
11. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

## 1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner. A history of each payment application may be viewed within Procore.
  1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

1. Contractor shall provide a draft of the Payment Application on the 25<sup>th</sup> of the month proceeding the end of the period for review by BMT, the IOR and the Architect.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. BMT and Architect will return incomplete applications without action.
  1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
  4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
  1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
  2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
  3. Provide summary documentation for stored materials indicating the following:
    - a. Materials previously stored and included in previous Applications for Payment.
    - b. Work completed for this Application utilizing previously stored materials.
    - c. Additional materials stored with this Application.
    - d. Total materials remaining stored, including materials with this Application.
- F. Transmittal: Submit four signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
  1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
  1. Submit required waivers on each item for amount requested in previous application, after deduction for retainage, on each item.

2. When an application shows completion of an item, submit conditional final or full waivers.
  3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
  5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of principal suppliers, fabricators, and subcontractors.
  2. Certified Schedule of Values.
  3. Contractor's Contractor schedule (preliminary if not final).
  4. Products list (preliminary if not final).
  5. Copies of building permits.
  6. Certificates of insurance and insurance policies.
  7. Performance and payment bonds.
  8. Data needed to acquire Owner's insurance.
  9. Construction Schedule
  10. Submittal Schedule (Design Schedule)
  11. Certified Payroll
  12. Storm Water Pollution Prevention Plan (SWPPP)
- I. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Occupancy permits and similar approvals by authorities having jurisdiction over Work.
  3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  4. Updated final statement, accounting for final changes to the Contract Sum.
  5. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
  6. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
  7. AIA Document G707, "Consent of Surety to Final Payment."
  8. Evidence that claims have been settled.
  9. Removal of temporary facilities and services.
  10. Testing, adjusting and balance records.

11. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
12. Start-up performance reports.
13. District training and orientations.
14. Operating and maintenance instruction manuals.
15. Preliminary Warranties, guarantees and maintenance agreements
16. Delivery of extra materials, products and/or stock.
17. Final liquidated damages settlement statement.
18. Retention Escrow Deposit Request Form (if applicable)
19. Consent of Surety to Final Payment
20. Conditional Waiver and Release Upon Final Payment (Contractor/Subcontractor)
21. Unconditional Waiver and Release Upon Final Payment (Contractor/Subcontractor)
22. Notice of Project Completion & Recommendation of Acceptance (w/required attachments)
23. Final Punch List
24. Certification Re Insurance
25. Certification Re Satisfaction of Indebtedness
26. Guarantee Form
27. Asbestos and Other Hazardous Materials Certification
28. SWPPP and NPDES District Requirements for Maintenance.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900



**SUPERSEDE - REPLACED**

**SECTION 01 29 00 - PAYMENT PROCEDURES**

**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. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections include the following:
  - 1. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
  - 2. Section 01 32 00 "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule.

**1.3 DEFINITIONS**

- A. Site Visit: Architect's visits to the site at intervals necessary in the judgment of Architect to become generally familiar with the progress and quality of the Work completed and to determine in general if the Work completed is in accordance with the Contract Documents. Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work.
- B. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

**1.4 SCHEDULE OF VALUES**

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
  - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
    - a. Application for Payment forms with Continuation Sheets.
    - b. Submittals Schedule.

- c. Items required to be indicated as separate activities in Contractor's Construction Schedule.
  2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the Schedule of Values:
    - a. Project name and location.
    - b. Name of Architect.
    - c. Architect's project number.
    - d. Project Manager's name and address.
    - e. Contractor's name and address.
    - f. Date of submittal.
  2. Arrange schedule of values consistent with format of AIA Document G703.
  3. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
    - a. Related Specification Section or Division.
    - b. Description of the Work.
    - c. Name of subcontractor.
    - d. Name of manufacturer or fabricator.
    - e. Name of supplier.
    - f. Change Orders (numbers) that affect value.
    - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
      - 1) Labor.
      - 2) Materials.
      - 3) Equipment.
  4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of Contract Sum. Break down principal subcontract amounts into separate labor and materials items. Breakdown of subcontractor's schedule of values must be true and accurate.
  5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
  6. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
    - a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.

7. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
9. Purchase Contracts: Provide a separate line item in the Schedule of Values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
10. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
  - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
11. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

## 1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
  1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date of each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
  2. Include amounts of work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
  4. Indicate separate amounts for work being carried out under Owner-requested project acceleration, if any.

- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and off-site.
1. Provide description of item(s) being stored.
  2. Location of the bonded warehouse(s) where materials or equipment is stored.
  3. Bill of sale made to Owner stating there will be no additional cost for transportation and delivery of the stored item(s).
  4. Statement certifying that item or any part thereof will not be installed in any construction other than Work under this Contract.
  5. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
  6. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
  7. Provide summary documentation for stored materials indicating the following:
    - a. Materials previously stored and included in previous Applications for Payment.
    - b. Work completed for this Application utilizing previously stored materials.
    - c. Additional materials stored with this Application.
    - d. Total materials remaining stored, including materials with this application.
- F. Transmittal: Submit four signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit notarized waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested, before deduction for retainage, on each item.
  2. When an application shows completion of an item, submit final or full waivers.
  3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  4. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
  5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors, principal suppliers and fabricators.
  2. Schedule of Values.

3. Contractor's Construction Schedule (preliminary if not final).
  4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
  5. Products list (preliminary if not final).
  6. Schedule of unit prices.
  7. Submittals Schedule (preliminary if not final).
  8. List of Contractor's staff assignments.
  9. List of Contractor's principal consultants.
  10. Copies of building permits.
  11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  12. Initial progress report.
  13. Report of preconstruction conference.
  14. Certificates of insurance and insurance policies.
  15. Performance and payment bonds.
  16. Data needed to acquire Owner's insurance.
  17. Initial settlement survey and damage report if required.
  18. Construction waste management program.
- I. Application for Payment at Substantial Completion: After issuance of the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements, including, but not limited to:
    - a. Transmittal of required Project Record Documents to Owner.
    - b. Evidence of completion of demonstration and training.
  2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  3. Updated final statement, accounting for final changes to the Contract Sum.
  4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
  5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
  6. AIA Document G707, "Consent of Surety to Final Payment."
  7. Evidence that claims have been settled.
  8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
  9. Final liquidated damages settlement statement.

10. Occupancy permits and similar approvals or certifications by governing authorities and franchised services, assuring Owner's full access and use of completed work.

## **1.6 REVIEW OF APPLICATION FOR PAYMENT**

- A. Draft Copy: Submit draft (pencil) copy of the Application for Payment ten days prior to due date for review by Architect.
- B. Draft Copy Review Meeting: The Owner, Architect and Contractor shall meet prior to payment application due date to review the draft (pencil) copy of the Application for Payment. Questions resulting from this review shall be answered by the Contractor and clarified prior to receipt of the official copy of the Application for Payment.
- C. Upon receipt of the official Application for Payment and other documentation as required by the Architect, including the updated Schedule of Values and the updated Contractor's Construction Schedule if required, the Architect shall review the documents received to determine if they correspond to the agreements reached during the draft copy review meeting. If necessary, the Architect shall revise the Application for Payment to correspond to the agreements reached, execute the Certificate for Payment, and forward the executed copies to the Owner.
- D. The Architect will rely on the accuracy and completeness of the information furnished by the Contractor. Issuance of a Certificate of Payment will not be deemed to represent that the Architect has performed audits of the supporting data.

## **PART 2 - PRODUCTS (Not Used)**

## **PART 3 - EXECUTION (Not Used)** **END OF SECTION 01 29 00**

## SECTION 012973 - SCHEDULE OF VALUES

### PART 1 - GENERAL

#### 1.01 DESCRIPTION

- A. Submit to the Long Beach City College, one (1) copy of an accurate and realistic Schedule of Values (Schedule) allocated to the various portions of the work, at least 15 days prior to the date of the Contractor's first application for payment.  
**Submittal shall be completed through Procore.**
- B. The Schedule of Values, unless objected to by the Long Beach City College, shall become the basis for the Contractor's application for payment.
  - 1. Upon request by the BMT, support values given with data that will substantiate their correctness.
  - 2. Payment for materials stored shall be limited to those materials approved by the BMT and is only at the Owners discretion.
- C. Related requirements specified elsewhere.
  - 1. Project General Requirements.
  - 2. Construction Schedule, Section 013210.

#### 1.02 FORM OF SUBMITTAL

- A. Identify schedule with:
  - 1. Title of project and location.
  - 2. Specification number.
  - 3. Name and address of Contractor.
  - 4. Date of submission.
- B. Schedule shall list the value of the component parts of work in sufficient detail to serve as a basis for computing values for progress payments during construction.
- C. Use the Construction Schedule (Section 013210) of the project specifications as a basis for the format for listing component items.
- D. List sub-values of major products or operations for each line item. Additional sub-values may be requested by the BMT.
- E. Costs for the various portions of the work:
  - 1. Each item shall include a directly proportion amount of the Contractor's overhead and profit.
  - 2. For items on which progress payments will be requested for stored products, list the total installed value, including Contractor's overhead and profit.
- F. A similar detailed schedule, itemizing costs and/or credits in a form satisfactory to the BMT shall accompany all quotations for changes in the work or for extra work.

- G. Round off figures to nearest ten dollars whenever possible.
- H. The sum of all values listed in the schedule shall equal the total contract sum.
- I. **Schedule of Values submittal to be sent through the Procore**

1.03 REVIEW AND RESUBMITTAL

- A. After review by the BMT, revise and resubmit Schedule as required. Resubmit revised Schedule in same manner.
- B. Progress payments will not be made until Schedule has been approved.

END OF SECTION 012973



## SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 1 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 project coordination procedures.
2. Administrative and supervisory personnel.
3. Coordination drawings.
4. Requests for Information (RFIs).
5. Project meetings.

- B. Related Sections:

1. Division 1 Section "Construction Schedule" for preparing and submitting Contractor's construction schedule.
2. Division 1 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Division 1 Section "Closeout Procedures" for coordinating closeout of the Contract.
4. Division 1 Section "Electric Project Management Information System" for coordinating with District's Electronic Project Management Information System (PMIS).

#### 1.3 DEFINITIONS

- A. RFI: Request from Owner, BMT, Architect, or Contractor seeking information from each other during construction.

#### 1.4 COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
  - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Preparation of Contractor's construction schedule.
  - 2. Preparation of the schedule of values.
  - 3. Installation and removal of temporary facilities and controls.
  - 4. Delivery and processing of submittals.
  - 5. Progress meetings.
  - 6. Pre-installation conferences.
  - 7. Project closeout activities.
  - 8. Startup and adjustment of systems.
  - 9. Project closeout activities.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
  - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

#### 1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings in accordance with requirements in individual Sections, where installation is not completely shown 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. Execution: The mechanical subcontractor shall prepare ductwork fabrication drawings and BIM model for review and coordination with the architect and other design consultants, the electrical, plumbing, sprinkler and other relative subcontractors. Drawings shall be in sufficient detail to show overall ductwork dimensions, clearances, and relative locations of work in allotted spaces. Ductwork routing and sectional elevations shall be provided for congested areas. The mechanical subcontractor will disseminate the ductwork drawings and will direct and expedite review by the various trades. Each trade shall indicate where conflicts or clearance problems exist for their work and subsequently seek resolution from the Architect/Engineer via General Contractor. Final coordinated drawings shall be produced by the mechanical subcontractor, who shall obtain approval for any changes to duct or pipe sizes and significant changes in routing. Electrical, sprinkler, and other relative subcontractors are required to participate in and cooperate fully with the coordination process.
    - a. The mechanical subcontractor to include the GC, Owner and Architect in BIM coordination meetings.
  
  2. 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. Coordinate the addition of trade-specific information to the 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.
    - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
    - f. Indicate required installation sequences.
    - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Construction Manager and the 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 sub-framing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures 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 1-1/4 inch 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: Construction Manager and Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are the Contractor's responsibility. If the Construction Manager and Architect determines that the coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, the Construction Manager and Architect will so inform the Contractor, who shall make changes as directed and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints in accordance with requirements of Division 1 Section "Submittal Procedures."

## 1.6 KEY PERSONNEL

- A. **Key Personnel Names:** Within **15 days** of starting construction operations, submit, **through Procore** a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

## 1.7 REQUESTS FOR INFORMATION OR INTERPRETATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
  2. **RFIs to be sent through Procore**
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
  2. Project number.
  3. Date.
  4. Name of Contractor.
  5. Name of BMT
  6. Name of Architect.
  7. RFI number, numbered sequentially.
  8. RFI subject.
  9. Specification Section number and title and related paragraphs, as appropriate.
  10. Drawing number and detail references, as appropriate.
  11. Field dimensions and conditions, as appropriate.
  12. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  13. Contractor's signature.
  14. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716, CSI Form 13.2A, or Contractor's comparable form. The Contractor is to use **Procore** for all RFI coordination, See General Conditions.

- D. Architect's Action: Architect will review each RFI, determine action required, and respond. **Allow seven working days for Architect's response** for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for coordination information already indicated in the Contract Documents.
    - d. Requests for adjustments in the Contract Time or the Contract Sum.
    - e. Requests for interpretation of Architect's actions on submittals.
    - f. Incomplete RFIs or inaccurately prepared RFIs.
  2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
  3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 1 Section "Contract Modification Procedures."
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify the BMT and Architect within seven days if Contractor disagrees with response.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly. Use CSI Log Form 13.2B or Contractor's comparable form. Include the following:
1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Architect.
  4. RFI number including RFIs that were dropped and not submitted.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date Architect's response was received.
  8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
  9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
- 1.8 PROJECT MEETINGS
- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify the BMT and Architect of scheduled meeting dates and times.
  2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  3. Minutes: The BMT will record significant conference discussions, agreements, and disagreements, including required corrective measures and actions. Distribute the meeting minutes to each party present, to parties who should have been present, and to other parties requiring information within three days of the meeting. **Historical meeting data will be available through Procore.**
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner, BMT and Architect.
1. Conduct the conference to review responsibilities and personnel assignments.
  2. Attendees: Authorized representatives of Owner, BMT, Architect, and their consultants; Contractor and its superintendent; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Tentative construction schedule.
    - b. Phasing.
    - c. Critical work sequencing and long-lead items.
    - d. Designation of key personnel and their duties.
    - e. Lines of communications.
    - f. Procedures for processing field decisions and Change Orders.
    - g. Procedures for RFIs.
    - h. Procedures for testing and inspecting.
    - i. Procedures for processing Applications for Payment.
    - j. Distribution of the Contract Documents.
    - k. Submittal procedures.
    - l. Preparation of record documents.
    - m. Use of the premises and existing building(s).
    - n. Work restrictions.
    - o. Working hours.
    - p. Owner's occupancy requirements.
    - q. Responsibility for temporary facilities and controls.
    - r. Procedures for moisture and mold control.
    - s. Procedures for disruptions and shutdowns.
    - t. Construction waste management and recycling.
    - u. Parking availability.
    - v. Office, work, and storage areas.
    - w. Equipment deliveries and priorities.
    - x. First aid.
    - y. Security.
    - z. Progress cleaning.
  4. Minutes: The BMT will record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

Distribute the meeting minutes to each party present, to parties who should have been present, and to other parties requiring information of the meeting. **Historical meeting data will be available through Procore.**

- C. Pre-installation Conferences: The Contractor shall conduct a pre-installation conference at Project site before each construction activity that requires coordination with other construction, or prior to a new subcontractor is about to start on site, so their scope can be understood by all parties.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
  2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Review of mockups.
    - i. Possible conflicts.
    - j. Compatibility problems.
    - k. Time schedules.
    - l. Weather limitations.
    - m. Manufacturer's written recommendations.
    - n. Warranty requirements.
    - o. Compatibility of materials.
    - p. Acceptability of substrates.
    - q. Temporary facilities and controls.
    - r. Space and access limitations.
    - s. Regulations of authorities having jurisdiction.
    - t. Testing and inspecting requirements.
    - u. Installation procedures.
    - v. Coordination with other work.
    - w. Required performance results.
    - x. Protection of adjacent work.
    - y. Protection of construction and personnel.
  3. Minutes: The Contractor is responsible for conducting meeting will record significant conference discussions, agreements, and disagreements, including required corrective measures and actions. Distribute the meeting minutes to each party present, to parties who should have been present, and to other parties requiring information within three days of the meeting. **Historical meeting data will be available through Procore.**



4. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a Project closeout conference, at a time convenient to Owner, BMT, IOR and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
  2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
    - a. Preparation of record documents.
    - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    - c. Submittal of written warranties.
    - d. Requirements for preparing operations and maintenance data.
    - e. Requirements for demonstration and training.
    - f. Preparation of Contractor's punch list.
    - g. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    - h. Submittal procedures.
    - i. Owner's partial occupancy requirements.
    - j. Installation of Owner's furniture, fixtures, and equipment.
    - k. Responsibility for removing temporary facilities and controls.
  4. Minutes: The BMT will record significant conference discussions, agreements, and disagreements, including required corrective measures and actions. Distribute the meeting minutes to each party present, to parties who should have been present, and to other parties requiring information. **Historical meeting data will be available through Procore.**
- E. Progress Meetings: The BMT will conduct progress meetings at weekly intervals or at intervals approved by Owner.
1. Contractor shall coordinate dates of meetings with preparation of payment requests.
  2. Attendees: In addition to representatives of Owner, BMT, Project Inspector and Architect, each contractor, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

- a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    - 1) Review schedule for next period.
  - b. Review present and future needs of each entity present, including the following:
    - 1) Interface requirements.
    - 2) Sequence of operations.
    - 3) Status of submittals.
    - 4) Deliveries.
    - 5) Off-site fabrication.
    - 6) Access.
    - 7) Site utilization.
    - 8) Temporary facilities and controls.
    - 9) Progress cleaning.
    - 10) Quality and work standards.
    - 11) Status of correction of deficient items.
    - 12) Field observations.
    - 13) Status of RFIs.
    - 14) Status of proposal requests.
    - 15) Pending changes.
    - 16) Status of Change Orders.
    - 17) Pending claims and disputes.
    - 18) Documentation of information for payment requests.
4. Minutes: The BMT will record significant conference discussions, agreements, and disagreements, including required corrective measures and actions. Distribute the meeting minutes to each party present, to parties who should have been present, and to other parties requiring information of the meeting. **Historical meeting data will be available through Procore.**
- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

Project No: 5824  
Gensler 005.2882.000

Addendum 01

Long Beach City College  
Construction Trades II Building  
Long Beach, California

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

## SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

**SUPERSEDE - REPLACED**

### 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. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General project coordination procedures.
2. Conservation.
3. Coordination Drawings.
4. Project Web site.
5. Administrative and supervisory personnel.
6. Project meetings.

- B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Section 01 32 00 "Construction Progress Documentation" for preparing and submitting the Contractor's Construction Schedule.
2. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 01 77 00 "Closeout Procedures" for coordinating Contract closeout.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities or as specified in individual Sections.

1. Indicate relationship of components shown on separate Shop Drawings.
2. Indicate required installation sequences.
3. Refer to Divisions in the Facility Services Subgroup for specific Coordination Drawing requirements for mechanical and electrical installations.

- B. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A in Document 00 60 00 "Forms." Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
  2. Number and title of related Specification Section(s) covered by subcontract.
  3. Drawing number and detail references, as appropriate, covered by subcontract.
- C. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
1. Post copies of list in project meeting room, in temporary field office, on Project Web site, and by each temporary telephone. Keep list current at all times.

#### **1.4 GENERAL COORDINATION PROCEDURES**

- A. Coordination: Coordinate construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  3. Make adequate provisions to accommodate items scheduled for later installation.
  4. Arrange pipes, ducts, conduits, and other overhead systems in an orderly manner when indicated to remain exposed.
- B. If necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's Construction Schedule.
  2. Preparation of the Schedule of Values.
  3. Installation and removal of temporary facilities and controls.
  4. Delivery and processing of submittals.

5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

## 1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown 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. Coordinate the addition of trade-specific information to the 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.
  - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
  - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
  - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
  - f. Indicate required installation sequences.
  - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate 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. Above-Ceiling Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures 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 1-1/4 inches 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 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 changes as directed and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 00 "Submittal Procedures."

## 1.6 PROJECT WEB SITE

- A. Project Web site for purposes of hosting and managing project communication and documentation until Final Completion. Project Web site shall include the following functions:
  1. Project directory.

2. Project correspondence.
3. Meeting minutes.
4. Contract modifications forms and logs.
5. RFI forms and logs.
6. Task and issue management.
7. Photo documentation.
8. Schedule and calendar management.
9. Submittals forms and logs.
10. Payment application forms.
11. Drawing and specification document hosting, viewing, and updating.
12. Online document collaboration.
13. Reminder and tracking functions.
14. Archiving functions.
15. .

- B. Provide up to seven Project Web site user licenses for use of the Owner, Owner's Commissioning Authority,, Architect, and Architect's consultants. Provide eight hours of software training at Architect's office for Project Web site users.
- C. On completion of Project, provide one complete archive copy(ies) of Project Web site files to Owner and to Architect in a digital storage format acceptable to Architect.
- D. Contractor, subcontractors, and other parties granted access by Contractor to Project Web site shall execute a data licensing agreement in the form of Agreement included in this Project Manual.

## 1.7 PROJECT MEETINGS

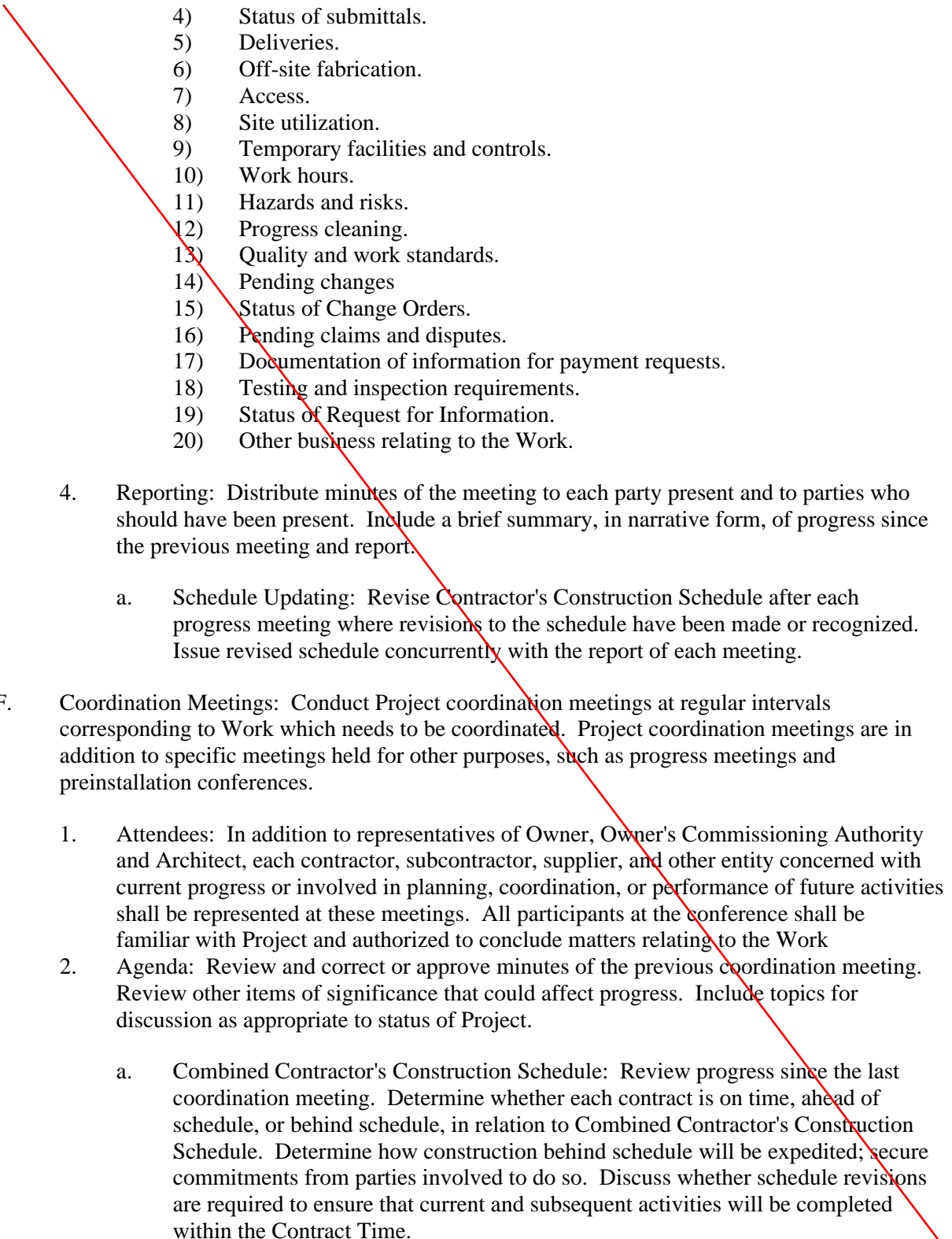
- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
  1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
  2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
  4. Notification: Inform participants three days prior to meetings not regularly scheduled.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 10 days after execution of the Agreement.

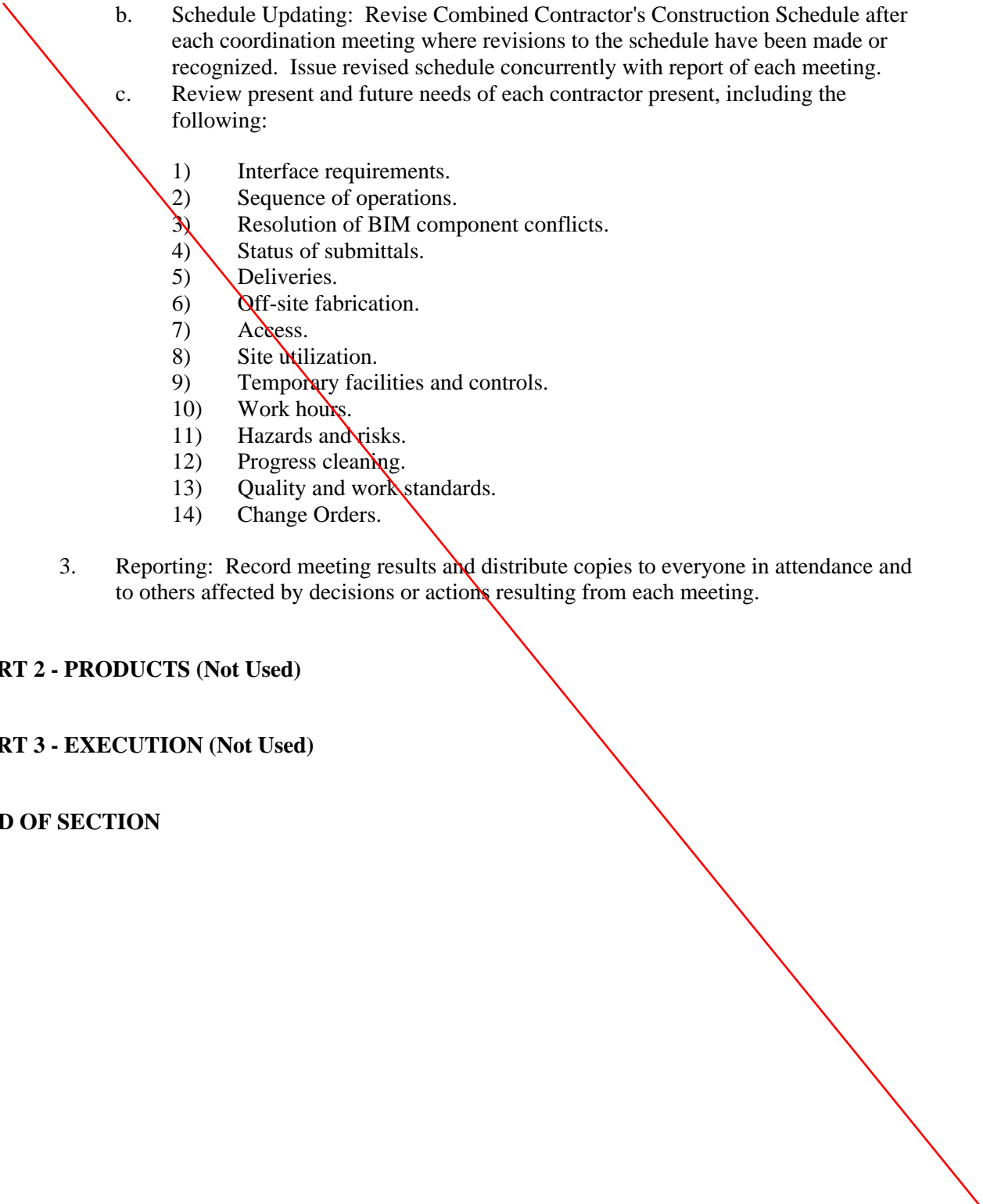


1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; manufacturers; suppliers; testing laboratory representatives; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Requirements in individual Specification Sections for preconstruction responsibilities.
    - b. Tentative construction schedule.
    - c. Project coordination
    - d. Phasing.
    - e. Critical work sequencing and long-lead items.
    - f. Designation of key personnel and their duties.
    - g. Lines of communication.
    - h. Procedures for processing Requests for Interpretation (RFIs.)
    - i. Procedures for processing Bulletins.
    - j. Procedures for processing submittals.
    - k. Procedures for processing substitution requests.
    - l. Procedures for processing field decisions, proposal requests and Change Orders.
    - m. Procedures for testing and inspecting.
    - n. Procedures for processing Applications for Payment.
    - o. Distribution of the Contract Documents.
    - p. Preparation of Record Documents.
    - q. Use of the premises.
    - r. Work restrictions.
    - s. Working hours.
    - t. Owner's occupancy requirements.
    - u. Responsibility for temporary facilities and controls.
    - v. Procedures for moisture and mold control.
    - w. Procedures for disruptions and shutdowns.
    - x. Construction waste management and recycling.
    - y. Office, work, and storage areas.
    - z. Equipment deliveries and priorities.
    - aa. First aid.
    - bb. Security.
    - cc. Progress cleaning.
  3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
  2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. Contract Documents.
    - b. Options.
    - c. Related RFI.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Review of mockups.
    - i. Possible conflicts.
    - j. Compatibility requirements.
    - k. Time schedules.
    - l. Weather limitations.
    - m. Manufacturer's written instructions.
    - n. Warranty requirements.
    - o. Compatibility of materials.
    - p. Acceptability of substrates.
    - q. Temporary facilities and controls.
    - r. Space and access limitations.
    - s. Regulations of authorities having jurisdiction.
    - t. Testing and inspecting requirements.
    - u. Installation procedures.
    - v. Coordination with other work.
    - w. Required performance results.
    - x. Protection of adjacent work.
    - y. Protection of construction and personnel.
  3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
  5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.

2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
    - a. Preparation of record documents.
    - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    - c. Submittal of written warranties.
    - d. Requirements for preparing operations and maintenance data.
    - e. Requirements for delivery of material samples, attic stock, and spare parts.
    - f. Requirements for demonstration and training.
    - g. Preparation of Contractor's punch list.
    - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    - i. Submittal procedures for closeout documents.
    - j. Coordination of separate contracts.
    - k. Owner's partial occupancy requirements.
    - l. Installation of Owner's furniture, fixtures, and equipment.
    - m. Responsibility for removing temporary facilities and controls.
- E. Progress Meetings: Conduct progress meetings at regular intervals.
1. Coordinate dates of meetings with preparation of payment requests.
  2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      - 1) Review schedule for next period.
    - b. Review present and future needs of each entity present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Resolution of BIM component conflicts.

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- 4) Status of submittals.
  - 5) Deliveries.
  - 6) Off-site fabrication.
  - 7) Access.
  - 8) Site utilization.
  - 9) Temporary facilities and controls.
  - 10) Work hours.
  - 11) Hazards and risks.
  - 12) Progress cleaning.
  - 13) Quality and work standards.
  - 14) Pending changes
  - 15) Status of Change Orders.
  - 16) Pending claims and disputes.
  - 17) Documentation of information for payment requests.
  - 18) Testing and inspection requirements.
  - 19) Status of Request for Information.
  - 20) Other business relating to the Work.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.
- a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: Conduct Project coordination meetings at regular intervals corresponding to Work which needs to be coordinated. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work
  2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to Combined Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

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- b. Schedule Updating: Revise Combined Contractor's Construction Schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
  - c. Review present and future needs of each contractor present, including the following:
    - 1) Interface requirements.
    - 2) Sequence of operations.
    - 3) Resolution of BIM component conflicts.
    - 4) Status of submittals.
    - 5) Deliveries.
    - 6) Off-site fabrication.
    - 7) Access.
    - 8) Site utilization.
    - 9) Temporary facilities and controls.
    - 10) Work hours.
    - 11) Hazards and risks.
    - 12) Progress cleaning.
    - 13) Quality and work standards.
    - 14) Change Orders.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION**

## SECTION 013119 - PROGRESS MEETINGS

### PART 1 - GENERAL

#### 1.01 DESCRIPTION

Scheduling and administration of progress meetings.

#### 1.02 RELATED REQUIREMENTS

- A. Instructions to Bidders
- B. Project General Requirements
- C. Construction Schedules
- D. Shop Drawings, Product Data and Samples
- E. Quality Control
- F. Temporary Facilities

#### 1.03 PROGRESS MEETINGS

- A. The CONTRACTOR will schedule Construction Progress Meetings, coordination meetings and pre-installation conferences throughout the progress of work. BMT will be responsible for the administrating and distributing meeting minutes from the weekly site meetings with the CONTRACTOR, but the CONTRACTOR is responsible to minute and distribute all other weekly subcontractor coordination and pre-installation meeting minutes.
- B. The BMT will set dates and times, make physical arrangements, prepare agenda and distribute notice of each meeting to Contractor, Architect, and Inspector of Record (IOR) in advance of or at meetings. **Agenda, along with all historical meeting data, will be distributed through Procore.**
- C. The BMT will preside at the weekly construction meeting with the CONTRACTOR; record minutes and distribute copies to participants.
- D. Location of meetings: Project's field office, Construction Site, or BMT's office.
- E. Attendance: BMT, IOR, Contractor or his authorized representative, and job superintendent, CONTRACTOR Architect. Subcontractors, suppliers and others shall attend as appropriate to agenda; Design Engineers and others shall attend when appropriate.
- F. Minimum Agenda :
  - 1. Approval of minutes of previous meetings.

2. Review of work progress.
3. Field observations, problems and decisions.
4. Identification of problems which impede planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Review, maintenance, and adjustment of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to Work.
14. Site safety.

END OF SECTION 013119

## SECTION 013130 - ELECTRONIC PROJECT MANAGEMENT INFORMATION SYSTEM

### PART 1 – GENERAL

#### 1.1 DESCRIPTION

- A. This Section is in addition to the Contract General Conditions.
- B. The Contractor shall be required to use the District's Electronic Project Management Information System (PMIS), **Procore** for electronic construction management document control and communications between the District, Architect of Record, Inspector of Record, other project-related consultants, and Contractor. The system will be maintained and owned by the District but operated collaboratively by the Project Team.
- C. The PMIS will contain the following information available to the contractor and project team:
  - 1. Change Orders (CO) and Logs
  - 2. Construction Change Directives (CCD) and Logs
  - 3. Daily Reports
  - 4. Field Observations and Reports
  - 5. Final Completion
  - 6. Incident Reports and Logs
  - 7. Inspection Requests (IR) and Logs
  - 8. IOR Daily Reports
  - 9. Meeting Minutes
  - 10. Notices to Proceed (NTP)
  - 11. Payment Applications
  - 12. Potential Change Orders (PCO) and Logs
  - 13. Requests for Information (RFI) and Logs



14. Submittals and Logs
  15. Substantial Completion
  16. Project FTP Site
  17. Electronic Drawings, Sketches, and Architect's Supplemental Instructions (ASI)
  18. Other Documentation as determined by the District's Representative.
- D. All Daily Reports, Incident Reports, IRs, PCOs, RFIs, and Submittals shall submit electronically, via the **Procore** Website. The District will NOT accept faxed and/or computer generated documentation and/or hand written documentation of these documents.
1. The Contractor shall be solely responsible for data entry via the **Procore** Website.
  2. The Contractor shall be solely responsible for the scanning of sketches / drawings as necessary for the electronic submittal and attachment of required information.
  3. The Contractor shall supply field personnel all necessary computer equipment required for electronic data entry.
  4. Submittals shall be submitted via **Procore**, with hard copies provided per Section 013300 Submittal Procedures.

## 1.2 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall have sufficient computer(s) with capabilities to access the system at their on-site and off-site project offices. At the pre-construction meeting, the Contractor shall provide to the District's Representative the email address of **all** Contractor representative(s) that the Contractor designates to have access to the PMIS. This representative(s) shall have sufficient computer skills required to access the Internet, log on to the PMIS, and utilize the PMIS. The District shall provide technical support to the Contractor's personnel for use of the PMIS. The Contractor shall plan on an average of 4-hours training for the Contractor's representative(s) who will be using the system. **Each representative shall complete the Procore Certification: Project Manager at GC (Project Management), and provide a copy of the completion certificate to BMT, prior to utilizing the PMIS.** Having the above capability in place on-site is a condition precedent to processing the Contractor's first payment request.

### 1.3 OFFICIAL RECORDS

- A. The documentation and records maintained on the PMIS will be the "Official Records" for the project. This documentation shall be the records for the adjudication of any and all disputes.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013130

## SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

### 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 and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Startup construction schedule.
  - 2. Contractor's construction schedule.
  - 3. Daily construction reports.
  - 4. Material location reports.
  - 5. Site condition reports.
  - 6. Special reports.
- B. Related Sections include the following:
  - 1. Section 01 29 00 "Payment Procedures" for submitting the Schedule of Values.
  - 2. Section 01 31 00 "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
  - 3. Section 01 33 00 "Submittal Procedures" for submitting schedules and reports.
  - 4. Section 01 40 00 "Quality Requirements" for submitting a schedule of tests and inspections.

#### 1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
  - 1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
  - 2. Predecessor activity is an activity that must be completed before a given activity can be started.
  - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.

- C. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
  - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
  - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.
  - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- F. Major Area: A story of construction, a separate building, or a similar significant construction element.
- G. Milestone: A key or critical point in time for reference or measurement.
- H. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format, unless indicated otherwise:
  - 1. Working electronic copy of schedule file, where indicated.
  - 2. PDF electronic file.
- B. Startup construction schedule.
  - 1. Approval of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- D. Construction Schedule Updating Reports: Submit with each Application for Payment.
- E. Daily Construction Reports: Submit at weekly intervals.
- F. Material Location Reports: Submit at monthly intervals.
- G. Site Condition Reports: Submit at time of discovery of differing conditions.
- H. Special Reports: Submit at time of unusual event.

- I. Qualification Data: For scheduling consultant.

## 1.5 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to the Preliminary Construction Schedule and Contractor's Construction Schedule, including, but not limited to, the following:
1. Review software limitations and content and format for reports.
  2. Verify availability of qualified personnel needed to develop and update schedule.
  3. Discuss constraints, including phasing, work stage,s interim milestones, and partial Owner occupancy.
  4. Review delivery dates for Owner-furnished products.
  5. Review schedule for work of Owner's separate contracts.
  6. Review submittal requirements and procedures.
  7. Review time required for review of submittals and resubmittals.
  8. Review requirements for tests and inspections by independent testing and inspecting agencies.
  9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
  10. Review and finalize list of construction activities to be included in schedule.
  11. Review procedures for updating schedule.

## 1.6 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
1. Secure time commitments for performing critical elements of the Work from parties involved.
  2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.
- C. Coordinate Contractor's construction schedule with Owner's construction schedule for Owner's own forces. Revise Contractor's construction schedule, if necessary, after a joint review and mutual agreement. The construction schedule shall then constitute the schedule to be used by Contractor, separate contractors and Owner until subsequently revised.

## **PART 2 - PRODUCTS**

### **2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL**

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.
1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
  2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Include selection process activities for finishes and products specified by allowances or specified to be selected during the sample review process. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
  4. Startup and Testing Time: Include not less than 15 days for startup and testing.
  5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
  6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
  7. Building Flush-Out: Include at least three days for building flush-out as indicated in Section 01 81 19 "Indoor Air Quality (IAQ) Management."
  8. Demonstration and Training: Training of Owner's personnel as indicated in Section 01 77 00 "Closeout Procedures." Section 01 79 00 "Demonstration and Training."
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
  2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
  3. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.

4. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
  5. Work Restrictions: Show the effect of the following items on the schedule:
    - a. Coordination with existing construction.
    - b. Limitations of continued occupancies.
    - c. Uninterruptible services.
    - d. Partial occupancy before Substantial Completion.
    - e. Use of premises restrictions.
    - f. Provisions for future construction.
    - g. Seasonal variations.
    - h. Environmental control.
  6. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
    - a. Subcontract awards.
    - b. Submittals.
    - c. Purchases.
    - d. Mockups.
    - e. Fabrication.
    - f. Sample testing.
    - g. Deliveries.
    - h. Installation.
    - i. Tests and inspections.
    - j. Adjusting.
    - k. Curing.
    - l. Building flush-out.
    - m. Startup and placement into final use and operation.
  7. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
    - a. Structural completion.
    - b. Temporary enclosure and space conditioning.
    - c. Permanent space enclosure.
    - d. Completion of mechanical installation.
    - e. Completion of electrical installation.
    - f. Substantial Completion.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- E. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.

1. Refer to Section 01 29 00 "Payment Procedures" for cost reporting and payment procedures.
- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
  2. Unanswered RFI.
  3. Rejected or unreturned submittals.
  4. Notations on returned submittals.
  5. Pending modifications affecting the Work and Contract Time.
- G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

## 2.2 STARTUP CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within seven days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

## 2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed. Base schedule on the Preliminary Construction Schedule and whatever updating and feedback was received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
  1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

## 2.4 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:



1. List of subcontractors at Project site.
  2. List of separate contractors at Project site.
  3. Approximate count of personnel at Project site.
  4. Equipment at Project site.
  5. Material deliveries.
  6. High and low temperatures and general weather conditions, including rain or snow accumulation.
  7. Accidents.
  8. Meetings and significant decisions.
  9. Unusual events (refer to special reports).
  10. Stoppages, delays, shortages, and losses.
  11. Meter readings and similar recordings.
  12. Tests and inspections, including name(s) of testing and inspection agency(ies).
  13. Emergency procedures.
  14. Orders and requests of authorities having jurisdiction.
  15. Change Orders received and implemented.
  16. Construction Change Directives received and implemented.
  17. Services connected and disconnected.
  18. Equipment or system tests and startups.
  19. Partial Completions and occupancies.
  20. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
1. Material stored prior to previous report and remaining in storage.
  2. Material stored prior to previous report and since removed from storage and installed.
  3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare a detailed report. Submit with a Request for Interpretation (RFI). Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

## 2.5 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

## **PART 3 - EXECUTION**

### **3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE**

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
  3. As the Work progresses, indicate Actual Completion percentage for each activity.
  4. Notify Owner and Architect a minimum of one week prior to issuance of updated schedule of all anticipated significant revisions to the Construction Schedule.
- B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post electronic copies of the updated project schedule on the project website.
  2. Post copies in Project meeting rooms and temporary field offices.
  3. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

**END OF SECTION**

## SECTION 013210 - CONSTRUCTION SCHEDULE

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

- A. Required procedures, preparation, submittals, reviews, updates, and revisions to the cost/schedule integrated construction schedule. The purpose of this section is to:
  - 1. Ensure adequate planning and execution of the Work by CONTRACTOR.
  - 2. Establish a standard against which satisfactory completion of the Project can be measured by OWNER.
  - 3. Assist CONTRACTOR and the BMT in monitoring progress.
  - 4. Aid in assessing the impact of any changes to the Contract.
  - 5. Provide justification for progress payments.

#### 1.02 RELATED SECTIONS

- A. General and Special Conditions
- B. Section 012900: Payment Procedures
- C. Section 013100: Project Management and Coordination
- D. Section 013300: Submittal Procedures
- E. Section 012973: Schedule of Values
- F. Section 014523: Testing and Inspection
- G. Section 015000: Construction Facilities And Temporary Controls
- H. Section 017700: Closeout Procedures

### PART 2 – PRODUCTS

#### 2.01 SCHEDULING SOFTWARE

- A. CONTRACTOR shall utilize Primavera P6 software (latest version) by Primavera Systems, Inc., or equivalent scheduling software to employ the Critical Path Method (CPM) in the development and maintenance of the construction schedule network using the Precedence Diagram Mode (PDM). The scheduling software shall be capable of being resource loaded with manpower, costs and

materials. It shall also be capable of generating time-scaled logic diagrams, resource histograms and profiles, bar charts, layouts and reports with any and/or all activity detail.

- B. All schedule calculation rules, auto cost rules and resource calculation rules shall be in a format acceptable to BMT. When schedule calculations are performed, the "Retained Logic" setting shall be used. CONTRACTOR shall use the zero (0) "Decimal Places" setting.

### PART 3 – EXECUTION

#### 3.01 SUBMITTALS

- A. CONTRACTOR shall retain a construction scheduler to work in enough capacity to perform all of the requirements outlined in this Section. CONTRACTOR shall submit, through Procore, a resume of the proposed Scheduler for review and acceptance prior to the preparation of any Schedule. The resume shall demonstrate the proposed scheduler's capability to plan, coordinate, execute, and monitor a cost/resource loaded CPM schedule as required for this Project and have a minimum of five (5) years direct experience using Primavera P6. Scheduler will cooperate with BMT and shall be available on site for monitoring, maintaining and updating schedules in a timely manner. BMT has the right to refuse to accept the Scheduler based upon a lack of experience as required by this Section or based on lack of performance and timeliness of schedule submittals/fragnets on past projects. If the BMT does not accept the proposed Scheduler, CONTRACTOR shall within one (1) week of disapproval, propose another scheduler who meets the experience requirements stated above.
- B. CONTRACTOR shall submit, through Procore, the Preliminary Construction Schedule within 10 days after Notice to Proceed (NTP).
- C. CONTRACTOR shall submit, through Procore, the Proposed Baseline Schedule as required by the date stipulated in Section 013210-3.04.
- D. CONTRACTOR shall submit the Monthly Schedule Updates, Four-Week Rolling Schedules, and Recovery Schedules as required.

#### 3.02 PRELIMINARY CONSTRUCTION SCHEDULE

- A. The purpose of the cost-loaded Preliminary Construction Schedule is to provide a mechanism in which to measure performance on individual activities and to validate the CONTRACTOR'S monthly Application for Payment on work performed (starting with month 1) during the first three months of the job until the complete Baseline Schedule is approved by the BMT.
- B. CONTRACTOR shall develop and submit, through Procore, a cost loaded Preliminary Construction Schedule as required by this Section. It shall be submitted in computer generated network format and shall be organized by Activity Codes representing the CONTRACTOR'S intended sequencing of the

Work. CONTRACTOR shall set dates and times for working meetings with BMT to review the Preliminary Construction Schedule. The Preliminary Construction Schedule shall include activities for the first 90 calendar days following the NTP such as mobilization, preparation of submittals, specified review periods, procurement items, fabrication items, milestones, and detailed construction activities.

- C. Upon BMT's acceptance of the Preliminary Construction Schedule, CONTRACTOR shall update the accepted Preliminary Construction Schedule each month (beginning with month 1) and submit these updates until CONTRACTOR'S Baseline Schedule is fully developed and accepted. Since updates to Preliminary Construction Schedule are the basis for payment to CONTRACTOR during the first three-month period, submittal and acceptance of such updates shall be a condition precedent to making of monthly payment, as referenced in General Conditions.
- D. Provide a written narrative describing CONTRACTOR'S approach to mobilization, procurement, and construction during the first 90 calendar days including crew sizes, equipment and material delivery, site access, submittals, and permits.
- E. Submit Bar Charts, Tabular Reports, a Cost flow Histogram, Electronic Data, and Plots in accordance with Section 013210.

### 3.03 SCHEDULE OF VALUES

- A. CONTRACTOR shall cost load activities in the Preliminary Construction Schedule and allocate costs to the cost accounts of all activities. The cost accounts shall match the CSI subsections listed in the Table of Contents of the Specifications. The format shall be coordinated with Article 8.3 (Progress Payment).
- B. Submit a computer-generated tabular report from the Preliminary Construction Schedule using the P6 scheduling software. The report shall contain the following data for each activity: Cost Account Number (by CSI subsection), Cost Account Description, Cost Account Budget, Cost to Date, Cost this Period, and Cost to complete. Total costs shall be organized and totaled by CSI subsection. This tabular report shall be the source of the data CONTRACTOR reports on the Schedule of Values.
- C. The cost loading associated with the activities shall be based on CONTRACTOR estimates of costs that CONTRACTOR will incur performing the specific activities. If BMT determines that the costs are front loaded and/or the distribution of costs is unreasonable, CONTRACTOR shall revise accordingly and resubmit the Schedule of Values within five (5) days for BMT's review.

### 3.04 BASELINE SCHEDULE CPM NETWORK

- A. Within thirty (30) days of the Notice to Proceed, CONTRACTOR shall submit, through **Procore**, a detailed Proposed Baseline Schedule that covers the entire

duration of the Project. This schedule shall convey CONTRACTOR'S plan for organizing, managing, and executing the Work.

- B. The Proposed Baseline Schedule shall include activity descriptions, sequencing, logic relationships, duration estimates, cost loading by CSI subsection, resource loading, and other information as set forth in this Section.
1. The Proposed Baseline Schedule shall include all Milestones stipulated in General Conditions, as well as all activities required to achieve timely completion of the Milestones.
  2. The Proposed Baseline Schedule shall include activities for: all construction activities, the NTP, Milestones, submittals, coordination drawings, re-submittals, procurement of materials and equipment, manufacturing, fabrication & delivery, owner furnished contractor installed items (OFCI), access restrictions, work restrictions, phased occupancy, testing, start-up, and contract closeout activities. The Proposed Baseline Schedule shall allow a period for BMT and ARCHITECT to review each submittal, as required by General Conditions Article 7.3 and other sections which require additional time for OWNER reviews and deferred submittal reviews by Division of State Architects (DSA).
  3. The Proposed Baseline Schedule shall include start and completion dates for: temporary facilities, construction of mock-ups, prototypes, samples, punch list, OWNER interfaces and furnishing of items, separate work contracts, regulatory agency approvals, and permits required for performance of the Work.
  4. The Proposed Baseline Schedule shall allow for all foreseeable factors and risks which affect performance of the Work. Include allowances for weather conditions, applicable laws, transportation, traffic, air quality, noise, or any other applicable regulatory requirements, regulations or collective bargaining agreements pertaining to labor.
  5. CONTRACTOR shall not use any float suppression techniques such as preferential sequencing or logic, special lead/lag constraints or unjustifiable over-estimating of activity durations in preparing the Proposed Baseline Schedule except that Finish No Later Than constraints are permitted for Milestones. No "Zero Free Float" constraints, No "Early" Constraints, and No "Mandatory Finish" constraints shall be utilized.
  6. The Proposed Baseline Schedule shall include activity durations based on the crew sizes and equipment utilization that CONTRACTOR will maintain during the Project. No activity durations shall exceed twenty (20) working days unless approved by the BMT. Non-construction activities such as procurement, fabrication, delivery, or submittal activities are exempted.

7. CONTRACTOR shall include with the Proposed Baseline Schedule a written narrative report sufficiently comprehensive to explain the rationale behind CONTRACTOR'S approach to the Work including but not limited to: activity durations, manpower flow, average crew sizes, equipment requirements, production rates, constraints, holidays and other non-work days, potential problem areas, permits, coordination with regulatory authorities, utilities, separate work contracts and other parties, and long lead delivery items requiring more than thirty (40) days from the date of order to delivery to the Project site.
- C. At the BMT request, furnish a detailed written explanation of CONTRACTOR'S basis for specific durations, logic, phasing, or other information. Such an explanation shall include CONTRACTOR'S rationale for selecting the number of crews, crew composition, number of shifts per day, number of hours in a shift, number of work days per week, construction equipment, and/or similar factors.
- D. The Proposed Baseline Schedule activities shall contain the following data:
  1. Activity ID numbers shall consist of no more than eight (8) alphanumeric characters. Following BMT acceptance of the Baseline Schedule, Activity ID numbers shall not be changed.
  2. Activity Descriptions shall provide adequate information that readily identifies each activity, work scope, and location.
  3. Activity codes specified in section 013210-3.04-G shall be applied to each activity.
  4. Cost accounts (in CSI subsection format) and Resource accounts shall be applied to each activity. They shall include lump sum costs, and man-hours/man-days (where applicable).
- E. At BMT's request, furnish a written explanation for each lead or lag relationship and each constrained date. Unjustifiable leads, lags, and constraints will result in BMT rejection of the Proposed Baseline Schedule.
- F. Calendar Identification: In the scheduling software, identify all activities that will require overtime shifts, double shifts, and work on weekends or holidays. Identify non-work days and holidays in the schedule calendar. All milestones stipulated in General Conditions shall be placed on a calendar with seven (7) days per week. No holiday or non-work-day restrictions are permitted on this calendar.
- G. Activity Codes: As a minimum, the Activity Codes shown in the Table 1 below shall be assigned to each activity and/or be identifiable in the schedule Work Breakdown Structure (WBS).

Table 1

Name	Length	Description
TYPE	2	Type of activity (mobilization, submittals, procurement/fabrication, construction, milestones, etc.)
AREA	2	Area and/or Building (General Conditions, Site, Basement, 1 <sup>st</sup> Floor, 2 <sup>nd</sup> Floor, Site Work, Elevators, Roof, etc.)
RESP	7	Responsible Party (subcontractor and/or trade)
SPEC	6	CSI Division and Specification number for Schedule of Values

The BMT may require additional coding of activities. The mandatory activity code requirements listed in Table 1 are not to be construed as setting limits on CONTRACTOR'S management and coordination responsibilities, but are intended to guide CONTRACTOR in the administration of its contractual responsibilities.

H. Milestones are designated dates as set forth in General Conditions in which Work or portions thereof are required to start and/or complete in accordance with the Contract Documents.

1. Where the term completion or similar terms are used in regards to a Milestone, it shall be construed to mean all portions of the Work in the indicated phase, area, and/or zone are complete and acceptable to BMT. Where the term start or similar terms are used in the designation of a Milestone, it shall be construed to mean a portion of the Work in the indicated phase, area, and/or zone is required to be commenced.
2. A Proposed Baseline Schedule extending beyond the Milestones and/or Contract Time will not be acceptable.
3. Finish Milestones shall be constrained with Late Finish (Finish No Later Than) type constraints in accordance with the dates stipulated in General Conditions.
4. In the scheduling software, in the "Project Overview" menu, assign the "Finish on or Before" date to match the Substantial Completion and Contract Completion Milestone dates stipulated in General Conditions.
5. A Proposed Baseline Schedule indicating Work completed in less time than the Milestones and/or Contract Time will not be acceptable. Rather, CONTRACTOR shall show any unused contract time as float.
6. Milestones shall be placed on a calendar with seven (7) days per week No Holiday or non-work-day restrictions are permitted on this calendar.
7. Schedule shall also include work milestone activities including, but not limited to: Demolition Complete, Foundation Complete, Sitework Complete, Elevator Complete, Building Weather Tight, Electrical Equipment Energized, Basement Complete,



- I. The Critical Path shall be clearly indicated on all schedules submitted. An activity is defined as critical when its Total Float is less than or equal to zero (0) days. The critical path is defined as the longest path.
- J. CONTRACTOR shall allow for inclement weather in the Proposed Baseline Schedule by incorporating an activity titled "Rain Day Impact Allowance" as the last activity prior to the Substantial Completion Milestone. No other activities may be concurrent with it. The duration of the Rain Day Impact Allowance activity will be based on Table #2 below, and will be calculated from the Notice to Proceed until the original date of Substantial Completion.

Table 2: Cumulative Calendar Days "Rain Day Impact Allowance": This Project will have a total of thirty (30) Rain days for the duration of the Construction.

When inclement weather at the Project site impacts Critical Path activities, CONTRACTOR may provide the BMT with a written request for a weather impact day describing the inclement weather delay on the Critical Path activities. The inclement weather delay must be clearly indicated by a 70% decrease in the field labor workforce hours on Critical Path activities on the day in question as indicated by CONTRACTOR'S Daily reports from the day in question and the scheduled work days prior to the day in question. Upon the BMT's independent confirmation of the amount of rainfall and impact, BMT will authorize CONTRACTOR to reduce the duration of the Rain Day Impact Allowance by one (1) day.

Inclement weather on non-scheduled workdays shall not be granted as weather impact days. If CONTRACTOR asks to work a specific weekend or holiday and gives BMT advanced, written notification of critical path work to be performed and a substantial amount of precipitation occurs that prevents the work from being performed, then that day can be claimed as a weather impact day. If the effects of inclement weather from a non-scheduled work day carry forward to a scheduled work day and impacts the Critical Path as noted above, then the scheduled work day will be considered impacted by weather. Any unused rain day allowance at the end of the project will be shown as available float to the Substantial Completion Milestone. Excusable, non-compensable time extensions will be granted for inclement weather to Substantial Completion milestone only after the weather impact area affecting the critical path work has exhausted the allotted cumulative Rain Day Impact Allowance.

K. Cost loaded Activities:

1. Each activity included in the Proposed Baseline Schedule shall be assigned the cost CONTRACTOR estimates it will incur performing that activity. Each activity's assigned cost will be inclusive of overhead and profit so CONTRACTOR'S total overhead and profit is distributed over all activities on a pro rata basis. The sum of the costs assigned to activities shall equal the total contract value. No activity costs shall be assigned to manufacturing or delivery activities unless approved by BMT. If the BMT finds that the costs are front loaded and the distribution of costs is unreasonable, CONTRACTOR shall re-distribute the costs and resubmit

the revised Schedule of Values within five (5) days for The BMT back check.

2. CONTRACTOR shall cost load activities in the Proposed Baseline Schedule and allocate costs to related resource/cost accounts associated with each activity. The cost accounts shall match the CSI subsections listed in the Table of Contents of the Specifications. All cost-loaded activities shall roll-up to their designated CSI subsections and shall be the basis for the data reported in the Schedule of Values.
  3. Submit computer generated tabular reports using the scheduling software which will be the basis for the approved Schedule of Values. The reports shall contain the following data for each activity: Cost/Resource Account Number (by CSI subsection), Cost/Resource Account Description, Cost/Resource Account Budget, Material Quantities and Unit Costs, Cumulative Quantities and Cost to Date, Material Quantities and Cost this Period, and Estimated Material Quantities and Cost at Completion. Total Material Quantities and Total Costs shall be organized and totaled by CSI subsection.
  4. Submit a Cost Flow Histogram in accordance with specification Section 013210, 3.04-L-3.
- L. CONTRACTOR shall submit computer generated reports and plots with the Proposed Baseline Schedule submittal package. Format shall display the following columns: Activity ID, Activity Description, Original Duration, Remaining Duration, Percent Complete, Early Start, Early Finish, Late Start, Late Finish, and Total Float.
1. Bar charts shall be generated separately for:
    - a. Milestones only.
    - b. All activities sorted by Early Start date and organized by Project, Area, Stage, & Sub-stage. (The network shall show continuous flow of all activities from left to right).
    - c. All activities sorted by Responsibility.
    - d. Summary level of all activities sorted by craft/trade and area.
  2. Tabular Reports:
    - a. Total Float sorted low to high.
    - b. Predecessors and Successors sorted by Activity ID.

3. Cost Flow Histogram
    - a. Using the costs assigned to each activity, develop a Histogram that projects the estimated invoice amounts by month for the Project duration. The histogram shall be produced from the scheduling software on 11x17 size paper (landscape mode). It shall contain both a monthly bar histogram and a cumulative cost curve on the same graph. The Total Costs shall be based on the Early Dates option.
  4. Man Power Histogram
    - a. Submit a planned man-power graphic bar histogram produced from the scheduling software on 11x17 size paper (landscape mode) that displays total man-hours based on Early Dates. Show both a weekly bar histogram and a cumulative curve on same graph. Upon the Construction Manger request, provide manpower broken down by trade.
  5. Provide a written narrative as required by Section 013210-3.04-B-7.
  6. Electronic data: Provide electronic P6 files in ".XER" type format.
- M. BMT will notify CONTRACTOR of any adjustments that are required for the Proposed Baseline Schedule to be accepted. CONTRACTOR shall perform any required adjustments to the Proposed Baseline Schedule and resubmit it for acceptance certifying in writing that all information contained therein complies with the Contract Documents. The BMT will review the Proposed Baseline Schedule for accuracy, reasonableness, and conformance with the Contract Documents and shall provide comments within ten (10) days of receipt. Within five (5) days after receiving BMT comments, CONTRACTOR shall both incorporate changes to address BMT concerns and resubmit the Proposed Baseline Schedule for BMT back-check. This process will continue until the Proposed Baseline Schedule is accepted as the Baseline Schedule. Once accepted by Construction Manger, the Baseline Schedule will be the basis upon which CONTRACTOR shall prepare updates that record and report actual performance and progress. The accepted Baseline Schedule and subsequent Monthly Updates (reference Section 013210 – 3.04 and 3.05 respectively) shall be the basis for consideration and analysis of requests for time extensions and CONTRACTOR progress payments.
- N. BMT acceptance of the Baseline Schedule or CONTRACTOR'S failure to identify and/or include any element of the Contract, shall not release CONTRACTOR'S obligation to complete all required Work in accordance with the Contract Documents.

### 3.05 REQUIREMENTS FOR MONTHLY/WEEKLY SCHEDULE UPDATING

- A. Once the Baseline Schedule is accepted by BMT, CONTRACTOR shall submit Monthly Schedule Updates beginning with month No. 1. The current month's

schedule update cannot be accepted until the previous Monthly Schedule Update has been accepted by BMT.

B. Monthly Schedule Update Format

1. Initially, the Contractor shall status a current Monthly Schedule Update with actual Work progress only. No logic ties shall be modified. Status all Actual Start and Finish dates, adjust Remaining Durations where needed, and update Percent Completion of cost and resource loaded activities. No activity Original Durations or Logic shall be changed unless authorized by BMT. No new activities shall be added unless authorized by the BMT.
2. Once the schedule is status in accordance with Section 013210-3.05-B1, CONTRACTOR shall print (and submit with Monthly Schedule Update) a report of "out-of-sequence" logic that results from the updating process. CONTRACTOR shall then correct all "out-of-sequence" logic to reflect CONTRACTOR'S actual Work sequence. If CONTRACTOR chooses to modify logic or add activities (other than out-of-sequence corrections), it shall be done in accordance with Section 013210-3.07 (Fragnets & Time Extensions Request).
3. During construction, CONTRACTOR may desire to break down specific activities into greater detail. If greater detail is necessary, then CONTRACTOR shall identify expanded activities such that the Baseline Schedule activities that the expanded activities originated from are readily apparent. CONTRACTOR shall not allow the aggregate duration of the expanded activities to exceed the duration assigned to the Baseline Schedule activity unless permitted by BMT in writing.
4. Autocost rules shall link Remaining Duration and Percent Complete.
5. The Data Date for the Monthly Schedule Updates shall be the last day of the month. At a minimum, three (3) days prior to the submission of the Monthly Schedule Update, CONTRACTOR shall meet in person with BMT to present the proposed Percentages of Completion and Actual Start and Actual Finish dates. Once percentages of completion and actual dates have been agreed to, they shall be the basis of the Monthly Schedule Update.
6. CONTRACTOR shall submit a Manpower Histogram that overlays a planned curve from the Baseline Schedule and a planned curve from the current Monthly Schedule Update.
7. Written Narrative Report: CONTRACTOR shall include a written report to explain the Monthly Schedule Update. The narrative shall, at a minimum include the following headings with appropriate discussions of each topic:
  - a. Introduction

- b. A Summary of Work which was on-going This Pay Period
  - c. Problem Areas and Proposed Solutions
  - d. Critical Path
  - e. Current and Anticipated Delays
  - f. Coordination of Work with Others
  - g. Milestone Status
8. In updating the Schedule, CONTRACTOR shall not modify Activity ID numbers, schedule calculation rules/criteria, or the Activity Coding Structure required.
  9. Submit bar charts, tabular reports, a cost flow histogram, man-power histogram, written narrative, electronic data, and plots in accordance with Specification Section 013210-3.04-L.
  10. Submit a cost-loaded report (progressed monthly) produced from the scheduling software that displays all of the activities organized by the CSI subsection cost/resource accounts. This report shall be in compliance with Section 013210-3.04-K, Section 012973 (Schedule of Values) and Section 012900 (Payment Procedures).
- C. Three-Week Look Ahead Schedule: At each Weekly Progress Meeting, CONTRACTOR shall present a Three-Week Schedule in Bar Chart format. It shall show one (1) week of actual and three (3) weeks of forecasted progress. The Three-Week Rolling Schedule shall be used as a basis for discussing progress and work planned during the three (3) weeks.
1. The Three-Week Look Ahead Schedule shall be based on the most recent BMT Accepted Monthly Schedule Update. It shall include weekly updates to all construction, submittal, fabrication/procurement, and separate work contract activities. CONTRACTOR shall ensure that it accurately reflects the current progress of the Work.
  2. CONTRACTOR shall discuss actual dates and any variances to critical or near critical activities.
  3. Upon request by Construction Manager, CONTRACTOR shall provide the Three-Week Look Ahead Schedule in electronic format.
  4. If the Three-Week Look Ahead Schedule indicates activities are behind schedule, CONTRACTOR shall provide a Recovery Schedule in accordance with Section 013210-3.06.

### 3.06 RECOVERY SCHEDULES

- A. If a Monthly Schedule Update indicates negative float greater than ten (10) days on a critical path as result of events not predicated by Article 7.4 of the General

Conditions CONTRACTOR shall prepare a Proposed Recovery Schedule demonstrating CONTRACTOR'S plan to regain the time lost. The Recovery Schedule shall be submitted either in advance of or concurrent with the Monthly Schedule Update and CONTRACTOR progress request. Both the Monthly Schedule Update and the Proposed Recovery Schedule shall be based on the same percentages of completion and actual dates accepted by BMT under Section 013210 – 3.05 B (Monthly Schedule Update Format).

- B. The Proposed Recovery Schedule shall be based on a copy of the Monthly Schedule Update for the calendar month during which the negative float first appears.
- C. The Proposed Recovery Schedule shall include a narrative that identifies the causes of the negative float on the critical path and provides CONTRACTOR'S proposed corrective action to ensure timely completion of all Milestones and the Substantial Completion Date. CONTRACTOR'S corrective actions shall include but are not limited to increasing concurrent operations, increasing labor, adding multiple shifts in a 24-hour period, and adding overtime.
- D. During any period of time when CONTRACTOR is found to be behind schedule by BMT, the Monthly Schedule Update described in Section 013210 – 3.05 shall become a weekly requirement to provide a greater degree of focus on the timely completion of the Work. These Updates shall be submitted to BMT every Monday morning. When CONTRACTOR is deemed by the BMT to be back on schedule, CONTRACTOR may revert to submitting the schedule monthly.
- E. CONTRACTOR'S progress payment may not be processed until the BMT accepts the Proposed Recovery Schedule. Following such an acceptance, the Proposed Recovery Schedule will be known as the Recovery Schedule and future Work will be performed by CONTRACTOR in accordance with it.

### 3.07 FRAGNETS & TIME EXTENSION REQUESTS

- A. Float is not for exclusive use or benefit of either OWNER or CONTRACTOR but is an expiring resource available to both parties on a non-discriminatory basis. If required to meet specified Milestones, either party may utilize float. Adjustments to Milestones and/or Contract Time will only be authorized by Change Order and only to the extent the claimed adjustments exceed total float along the most critical path of the current Monthly Schedule Update in effect at the time of the claimed adjustments. The claimed adjustments to the Milestones and/or Contract Time must also cause the Substantial Completion Date to exceed that currently indicated in the Monthly Schedule Update. CONTRACTOR claimed adjustments to an existing negative float path will not receive consideration until the activity with the highest negative float is driven even further negative.

Claimed adjustments to the Milestones and/or Contract Time will be administered in conjunction with those set forth in the General Conditions.

- B. Pursuant to the float sharing requirements of this Section, the use of float suppression techniques such as preferential sequencing or logic, special lead / lag logic restraints, and extended activity times or durations are prohibited. The use of float time disclosed or implied by the use of alternate float suppression

techniques shall be proportionally shared to benefit OWNER and CONTRACTOR. The use of any technique solely for the purpose of suppressing float will result in OWNER rejection of the submitted Monthly Schedule Update.

- C. In the event CONTRACTOR believes the Project has suffered an adverse impact arising from events predicated by Article 7.4 of the General Conditions, CONTRACTOR may prepare a Time Extension Request by submitting a Schedule Fragnet and a written narrative outlining the detail of the impact. A Schedule Fragnet must demonstrate a critical path delay. Such a delay must adversely impact the Substantial Completion Date for CONTRACTOR to receive a time extension. To demonstrate such an impact successfully, CONTRACTOR shall prepare a Schedule Fragnet based on a copy of OWNER accepted Monthly Schedule Update for the calendar month during which the adverse impact occurred. This "copy" of the OWNER accepted Monthly Schedule Update shall however first be updated (by OWNER and CONTRACTOR jointly) with both Percentages of Completion and Actual Dates up to the day the delay commenced. This process will provide the "pre-delay" project status. Once OWNER and CONTRACTOR have agreed to the "pre-delay" project status, CONTRACTOR should make a copy of this "pre-delay" schedule and this copy is to be the starting point for CONTRACTOR'S Schedule Fragnet development. OWNER will evaluate the activities, logic, durations, etc... in the Schedule Fragnet and will evaluate if the adverse impact arose from events described by Article 7.4 of the General Conditions. The Fragnet shall also include CONTRACTOR-caused delays that affect the critical or near critical path in the network and should be accounted for in the Time Impact Analysis if overlapped at any point in time with OWNER-caused delay. If rain impact days were granted between the Start and Finish of OWNER-caused delay period, they should be accounted for in the Time Impact Analysis as well. Provided OWNER determines such an impact occurred, CONTRACTOR may be due a time extension equal to the number of proportioned days of variance/delay that resulted to the Substantial Completion Date.
- D. All activities added into a Schedule Fragnet to demonstrate the impact of adverse event shall be assigned a unique activity code. The Schedule shall be organized by this unique activity code.
- E. The Schedule Fragnet shall incorporate logic that accurately ties reflective of the adverse event to pre-event predecessor activities and post event successor activities.
- F. The format and components of a Schedule Fragnet submittal shall be in accordance with Section 013210 and Article 7.4 of the General Conditions. It is crucial for the Fragnet to be submitted within the same month of discovery so it can be resolved during the monthly schedule update review. The notice shall be transmitted to BMT within the stipulations outlined in Article 9 of the General Conditions.
- G. If OWNER accepts CONTRACTOR'S Schedule Fragnet and an extension is granted, a Change Order will be prepared. OWNER will advise what change order number the time extension will become. When CONTRACTOR receives this Change Order number, all the activities added to the Schedule Fragnet shall be given Activity Identification Numbers that corresponds with the Change Order

number. CONTRACTOR shall cost load and resource-load the activities if required by OWNER. If resource loading is required, the resource loading shall include a breakdown of labor, material, and equipment quantities.

- H. If OWNER rejects CONTRACTOR'S Schedule Fragnet in part based on improper forecast logic or activity tasks then it shall be revised accordingly to conform to the OWNER'S review comments and resubmitted. If the forecast logic and activity tasks cannot be agreed to then the pre-delay schedule outlined in Section 013210-3.07-C shall be compared to the actual as-built data in the succeeding month of the encountering issue, event, condition, circumstance, and/or cause. The variance to the project between the pre-delay and post delay schedules shall be discussed in CONTRACTOR'S written narrative and proportioned between the different parties involved in the delay.
- I. If OWNER rejects CONTRACTOR'S Schedule Fragnet in whole then CONTRACTOR may follow the procedures set forth in Article 16 of the General Conditions.

### 3.08 PAYMENT FOR SCHEDULING

- A. The Work in Section 013210 will be included as part of the bid price.
- B. Preparation, revising, maintenance, and compliance with Section 013210 is an integral part of the Contract Documents and is specified to have a minimum value equal to 2% of the original Contract Amount or \$150,000, whichever is less. This amount shall be cost loaded into an activity titled "Construction Schedule" in both the Proposed Baseline Schedule and the Schedule of Values described in Section 012973.
  - 1. CONTRACTOR may bill twenty percent (20%) of the amount cost-loaded in the "Construction Schedule" activity when the BMT accepts the Proposed Baseline Schedule as the Baseline Schedule.
  - 2. The remaining eighty percent (80%) may be billed in equal monthly increments. The amount of those increments is determined by dividing the remainder of the amount cost-loaded in the "Construction Schedule" activity divided by the total number of months in the Contract Time. Payment of these incremental amounts is contingent upon BMT acceptance of CONTRACTOR Monthly Schedule Updates, Recovery Schedules, Three-Week Look Ahead Schedule and the updated Log of Required Submittals.

### 3.09 FAILURE TO COMPLY WITH REQUIREMENTS

- A. At any time during the project if CONTRACTOR fails to comply with the specified requirements, OWNER reserves the right to engage independent estimating and/or scheduling consultants to fulfill these requirements. Upon notice to CONTRACTOR, OWNER shall assess against CONTRACTOR, all incurred costs for these additional services.
- B. In such an event, OWNER will require, and CONTRACTOR shall participate and provide all requested and/or required information to ensure the resulting



Milestones Schedule accurately reflects CONTRACTOR plan to execute the Work in compliance with the Contract Documents. If it becomes necessary for OWNER to recommend logic and/or duration revisions as a result of CONTRACTOR failure to furnish acceptable data, and if CONTRACTOR has objections to the recommendations, CONTRACTOR shall provide notice to OWNER within three (3) days and CONTRACTOR shall provide an acceptable alternate plan. If CONTRACTOR fails to so note any objections and provide an acceptable alternate plan, or if CONTRACTOR implements the recommendations of OWNER without so noting any objections, CONTRACTOR will be deemed to have waived all objections and concurred with the recommended logic/duration revisions provided by ARCHITECT and/or OWNER.

- C. Submittal of any Monthly Schedule Updates is subject to review and acceptance by OWNER. OWNER retains the right, including, but not limited to Article 8 of the General Conditions, to withhold progress payments in whole or part until CONTRACTOR submits a Monthly Schedule Update acceptable to OWNER.

### 3.10 CONTRACTOR RESPONSIBILITY

- A. Nothing in this Section shall be construed to be a usurpation of CONTRACTOR authority, responsibility, and obligation to plan and schedule Work as CONTRACTOR deems necessary, subject to all other requirements of the Contract Documents.
- B. CONTRACTOR shall involve the subcontractors, manufacturers, and suppliers in the development and periodic updating of the schedule.

### 3.11 RECORD DOCUMENTS

- A. Prior to Contract Completion of the Work, CONTRACTOR shall submit, through Procore, an as-built time-scaled network diagram reflecting the actual dates of all activities.

END OF SECTION 013210



Hazardous Material Removal Specifications  
Long Beach Community College  
Pacific Coast Campus  
Building MM Phase II Project  
1305 East Pacific Coast Highway, Long Beach, California

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Vista Project No. 20 0210 013

April 2, 2021

NOTE: NOT REVIEWED BY DSA

**ADDENDUM 3 - RFI 53**

53. Q: Per section 024116, paragraph 1.6, C, and Vista Environmental spec 013280, please confirm that HAZ Material disposal identified in 013280 is in Contractors Scope of Work.

A: Disposal of hazardous material shall be included in Base bid.

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**SECTION 013280 - HAZARDOUS MATERIALS REMOVALS****PART 1 - GENERAL****1.1 PROJECT SITE**

- A. The project site is identified as the Building MM Phase II Project, encompassing the demolition of the Center and East Wings of Building MM on the Pacific Coast Campus of Long Beach Community College, located at 1305 East Pacific Coast Highway in Long Beach, CA. Work areas shall include all areas where hazardous materials are to be impacted as part of demolition and renovation/modernization activities, as outlined in Table 1, located in Article 1.2.G, below.

**1.2 SCOPE OF WORK**

- A. The goal for this project is the demolition of the Center and East Wings of Building MM. All hazardous materials to be impacted during the demolition scope of the project are to be removed prior to follow-on demolition activities associated with this project.
- B. All removal and disturbance of asbestos-containing materials shall be performed by an asbestos abatement contractor, using 32-hour asbestos certified workers (Asbestos Worker trained as outlined in 40 CFR 763). Abatement contractor's workforce shall be supervised by experienced persons trained, knowledgeable and qualified in the techniques of asbestos abatement, handling and disposal of asbestos-containing and/or asbestos-contaminated materials, and the subsequent cleaning of contaminated areas, including, at a minimum, Competent Person/Contractor Supervisor training as outlined in 40 CFR 763.
- C. All removal and disturbance of lead-based materials shall be performed by a state-licensed contractor using properly trained, Cal/DPH-certified workers, as appropriate, with at least one Cal/DPH-certified Supervisor. All removal and disturbance of lead-containing materials (not meeting the definition of "lead-based", as defined in 8 CCR 1532.1), shall be performed by a state-licensed contractor, using lead-trained workers with certification of training meeting the requirements of 8 CCR 1532.1. Abatement contractor's workforce shall be supervised by experienced persons trained, knowledgeable and qualified in the techniques of lead abatement, handling and disposal of lead-containing and/or lead-contaminated materials, and the subsequent cleaning of contaminated areas.
- D. When exposure monitoring of a particular lead-related task indicates that the permissible exposure limit (PEL) is or will be exceeded, the contractor shall use Cal/DPH-certified lead workers to complete the task. Contractors performing work that disturbs any Lead-Containing Materials (LCM) must submit proof of negative exposure assessment (NEA) if personal protective equipment is not to be used.
- E. For Cal/OSHA compliance purposes, all other painted, varnished, and glazed surfaces identified in the Hazardous Materials Survey Report (see Attachment A) require that contractors performing activities that disturb these surfaces/materials comply with the requirements of 8 CCR 1532.1. These surfaces were identified in the above-referenced report to have detectable levels of lead, at concentrations less than 0.7 mg/cm<sup>2</sup> lead (the LBP standard) by X-Ray fluorescence.

- F. Contractor shall utilize employees with appropriate training per applicable regulations, as outlined in 29 CFR 1910.120 and 8 CCR 5192, when handling all “other” hazardous materials, including PCBs, refrigerants and Universal Waste Rule items.
  
- G. Contractor shall furnish all labor, materials, services, insurance (specifically covering the handling and transportation of asbestos, lead, and other hazardous materials), and equipment which is specified, shown or reasonably implied for the removal, transportation and disposal of the hazardous materials identified in the following tables, which will be impacted by project work:

**Table 1 - Hazardous Materials Summary – LBCCD, Building MM Phase II Project Area**

MATERIAL	DESCRIPTION	LOCATION	CONTAMINANT	ESTIMATED QUANTITY <sup>1</sup>
Pipe Insulation	Hard Pack With Canvas Wrap	Throughout Building	Friable ACM	350 LF (See Note 1)
Fitting Insulation	Hard Pack With Canvas Wrap	Throughout Building	Friable ACM	25 Fittings <b>(See Note 2)</b>
12” Vinyl Floor Tile	Grey over Red	Room 120A	Class I Non-Friable ACM	100 SF (See Note 3)
9” Vinyl Floor Tile and Mastic	Beige Tile & Black Mastic	Rooms 101, 105, 107, 110 and Corridor of Center Wing	Class I Non-Friable ACM	4,820 SF (See Note 4)
12” Vinyl Floor Tile and Mastic	Grey Tile w/ Specks & Black Mastic	Rooms 100, 100A, 104 and 108	Class I Non-Friable ACM	920 SF
Mop Sink	Terrazzo-like	Custodial Closet	ACCM (Assumed ACM)	1 Sink
Mastic a/w 12” Vinyl Floor Tile	Black Mastic (beneath pink tile)	Pantry	Class I Non-Friable ACM	20 SF
Residual Mastic	Black	Rooms 100A and 102	ACCM (Assumed ACM)	800 SF
8” OD Heat Exhaust Flues	Transite™	Roof Penetrations	Class II Non-Friable ACM	8 Pipes <b>(See Note 5)</b>
Porcelain Rectangular Sinks	White	Room 118 and 120	LBP	3 Sinks
Ceramic Wall Tile	Tan	Room 118	LBP	80 SF
Safety Lines on Concrete	Yellow	Room 118	LBP	200 LF
Paint on Steel Beam	Beige and Light Blue	Room 124	LBP	See Note 6
Paint on Wood Door Frames	White	Room 124B	LBP	3 Doorways
Paint on Wood Door Frames	Off-White	Room 124	LBP	4 Doorways
Paint on Suspended Heaters	Light Blue	Room 120	LBP	13 Heaters
Porcelain Wall-Mounted Sinks	White	Room 107, MRR and WRR	LBP	3 Sinks

MATERIAL	DESCRIPTION	LOCATION	CONTAMINANT	ESTIMATED QUANTITY <sup>1</sup>
Porcelain Cabinet-Mounted Sink	White	Room 103A	LBP	1 Sink
Ceramic Wall Tile	Blue	MRR	LBP	140 SF
Ceramic Wall Tile	Tan	WRR	LBP	140 SF
Floor Drains/Covers	Brass	MRR and WRR	LBP	12 Drains
Paint on Metal Canopy Posts	Grey	Canopies Around Building	LBP	16 Posts
Paint on Wood Canopy Beams	Grey	Canopies Around Building	LBP	980 LF
Roof Vent Jackets	Pure Lead	Roof Penetrations	LBP	23 Jackets
HVAC Wall Post Jackets	Pure Lead	Roof Penetrations	LBP	28 Jackets
Floor Drains/Covers	Grey	Roof	LBP	6 Drains
Paint on Metal Elongated Vent Ducts	Tan/White	Roof	LBP	180 LF
Paint on Metal Window Frames	Grey	Exterior of Building	LBP	283 Windows
Paint on Metal Duct	Beige	East Side of Building, from Roof, Associated w/ Dust Collector	LBP	80 SF
Paint on Round Metal Duct	Tan	Roof, Associated w/ Dust Collector	LBP	110 LF
Paint on Metal Support Frame	Tan	Roof, Associated w/ Dust Collector	LBP	360 LF
Paint on Rectangular Metal Signs	Blue (black part not LBP)	Building MM Signs Around Building	LBP	120 SF
Paint on Concrete Benches	Blue	Courtyard on North Side of Building	LBP	5 Benches
Paint on Metal Louvers	Beige	Courtyard on North Side of Building, Above Canopy	LBP	2 Louvers
Refrigerant (R-410A)		Six Roof-Mounted Chiller Units	CFC	94 Pounds
Refrigerant (R-22)		Drinking Fountain in Room 120 and Window-Mounted A/C Unit in Room 120A	CFC	2 Pounds
Batteries within Lighted Exit Signs		Exit Signs near Exits Throughout Building	UWR	6 Exit Signs
Fluorescent Lighting Tubes (Hg) – 4'		Lighting Throughout Building	UWR	540 4' Tubes
Fluorescent Lighting Tubes (Hg) – CFLs		Exterior Lighting	UWR	22 CFLs
Fluorescent Lighting Ballasts (potential PCB)		Inside Fluorescent Lighting Fixtures	UWR/PCBs	230 Ballasts

MATERIAL	DESCRIPTION	LOCATION	CONTAMINANT	ESTIMATED QUANTITY <sup>1</sup>
Exterior Concrete Seam Caulking (TSCA-regulated PCB Bulk Product)		North and South Seams of connection between Center Wing and West Wing	PCBs	2 Seam Lines (See Note 7)
<p>Notes to Table 1:</p> <ol style="list-style-type: none"> <li>This material was observed in rooms and accessible ceiling plenums throughout the building. It is possible that additional material could be present in inaccessible areas, such as fully-enclosed mechanical chases or plenums.</li> <li>This material was observed in rooms and accessible ceiling plenums throughout the building. It is possible that additional material could be present in inaccessible areas, such as fully-enclosed mechanical chases or plenums. <b>Please note that this material contains both 15% Chrysotile and 10% Amosite Asbestos.</b></li> <li>This assembly involves two layers of floor tile and adhesive. The visible (top) layer is a 12" grey vinyl composition tile, beneath which is brown mastic, a red vinyl tile of unknown size, and black mastic. In this entire assembly, the only ACM is the red tile, but the upper layers cannot reasonably be removed without impacting the ACM red tile.</li> <li>It appears that this material may also be present beneath the ceramic floor tile in Room 120B, which would add another 110 square feet of material.</li> <li><b>Please note that this material contains both 15% Chrysotile and 3% Crocidolite Asbestos.</b></li> <li>The structural steel was found to be a lead-based paint in multiple areas. Regardless of the color of paint identified on the structural steel, including beige, light blue, and any other colors encountered, there is a lead-based paint corrosion inhibitor beneath the colored finish paint. All structural steel within the building is coated with lead-based paint.</li> <li>Removal of the PCB Bulk Product Waste may be performed in accordance with this document. Work required to address PCB-contaminated soil and PCB-contaminated concrete to remain, associated with the West Wing, must be performed in accordance with a USEPA-approved PCB Remediation Work Plan.</li> <li>Due to the small quantity and the similarity in work procedures, the two items determined to be ACCM via asbestos bulk sampling were assumed to be ACMs, rather than subjecting these materials to point-count analysis.</li> </ol>				
<p><u>General Notes:</u></p> <p><u>ACMs</u> = Asbestos-Containing Materials                      <u>UWR</u> = Universal Waste Rule  <u>PCB</u> = Polychlorinated Biphenyls                              <u>LF</u> = Linear feet  <u>SF</u> = Square feet</p> <p><u>LBP</u> = Lead-Based Paint. Contains 1.00 milligrams per square centimeter (mg/cm<sup>2</sup>) of lead or greater, or 5,000 mg/kg of lead or greater, as defined by 17 California Code of Regulations (CCR) 35001-36100. In Los Angeles County, the more stringent LACDPH standard of 0.7 milligrams per square centimeter (mg/cm<sup>2</sup>) of lead applies.</p> <p><sup>1</sup> Order of Magnitude <b><u>ESTIMATED</u></b> Quantities and Locations <b><u>ARE NOT</u></b> to be used for bidding purposes. It is the sole responsibility of the contractor to verify quantities and locations of hazardous materials in the path of construction through site visits and contractual bid set documents, including, but not limited to all specifications, drawings, and addenda. Any discrepancies between the contractual bid set documents and site visits must be submitted in writing <b><u>PRIOR</u></b> to bidding.</p>				

- H. The Work includes the removal, transport and disposal of the following contaminated Materials:
  1. All hazardous materials identified in the table (Table 1) in Article 1.2.G, above.
  2. All materials used for work area preparation.
  3. All discarded personnel protective equipment.
  4. All other potentially contaminated materials.
  
- I. Other items of work shall include:
  1. As per agreement between Contractor and Owner.

- J. Replacement of removed materials:
  - 1. As per agreement between Contractor and Owner. Where replacement applies, replacement materials shall be free of Asbestos, Lead, PCBs or any other material deemed hazardous by the State of California.
- K. Furnishings, cabinets, moveable objects, and equipment temporarily removed to gain access to hazardous materials shall be retained for salvage by the College, unless other arrangements and approval have been provided by the Owner.
- L. Damages caused during the performance of abatement activities shall be repaired by Contractor (e.g., damages to utilities, structures or finishes to remain) at no additional expense to Owner, unless other arrangements and approval have been provided by the Owner.
- M. Listed quantities are for budgetary information and are not to be used for bidding purposes. The abatement contractor has the sole responsibility for confirming the location, quantity and degree of difficulty in removing the identified materials.

### **1.3 WORK TO BE PERFORMED BY OTHERS**

- A. As per Project Specifications.

### **1.4 RESPONSIBILITIES OF OWNER**

- A. The Owner will provide daily oversight of and environmental monitoring surrounding the abatement/removal operations.
- B. The abatement contractor shall coordinate with the Owner for the location of equipment storage, staging and waste storage locations.
- C. The abatement contractor shall be responsible for all aspects of hazardous waste management, storage, transportation and disposal.

### **1.5 REQUIRED LICENSURE**

- A. Contractor shall be licensed by the State of California, Contractors State License Board and be registered to perform asbestos related work with the Division of Occupational Safety and Health, Department of Industrial Relations. At a minimum contractor shall hold the following license classifications:
  - 1. DOSH ASB - Asbestos Certification
  - 2. CSLB C-22 (Asbestos Abatement) license.
- B. Subcontractors shall hold all licenses applicable to specified trade work.

### **1.6 PERMITS**

- A. As required by Cal/OSHA.
- B. As required by the South Coast Air Quality Management District.
- C. As required by Cal/DPH.



- D. PCB remediation shall only be performed in accordance with a USEPA-approved PCB Remediation Work Plan.
- E. As required by local agencies for specific tasks (i.e., electrical permit for temporary power, etc.).

**1.7 NOTIFICATIONS**

- A. Contractor shall make all required written notifications to regulatory agencies, as-needed, including the following:
  - 1. California Division of Occupational Safety and Health (Cal/OSHA), in accordance with 8 CCR 1529 and/or 8 CCR 1532.1, as applicable.
  - 2. South Coast Air Quality Management District (SCAQMD), in accordance with Rule 1403.
  - 3. California Department of Public Health (Cal/DPH), in accordance with 17 CCR 35000-36100.

**1.8 INSURANCE REQUIREMENTS**

- A. Contractor and all subcontractors shall maintain, at a minimum, workers compensation insurance at the statutory limits required. This shall, at a minimum, include the limits necessary to maintain their DOSH Asbestos Certification in good standing.
- B. Contractor shall maintain general liability insurance with a minimum rating of A RATING, with a limit of \$5 Million per occurrence and \$5 Million aggregate coverage.
- C. Contractor shall maintain pollution and environmental liability insurance with the same limits and rating requirements as the general liability insurance requirements in Item 1.8.B, above.
- D. Contractor and all subcontractors shall maintain, at a minimum, auto insurance with a minimum rating of A RATING, and a limit of \$2 Million per occurrence and \$2 Million aggregate coverage.

**1.9 BONDING REQUIREMENTS**

- A. Please refer to Project Specification General Conditions and Requirements.

**1.10 PROJECT SCHEDULE**

- A. Project Start Date: TBD Project Completion Date: TBD
- B. All work shall be performed as per agreement between Contractor and Owner.
- C. For the purposes of this Work Plan "submittal due date" shall mean the day on which submittals required by Article 1.12 shall be received by the Construction Manager, "start work" shall mean the day Contractor arrives on the project site, and "completion date" shall mean the day Contractor leaves the project site including final clearance testing and demobilization.

- D. Contractor to indicate the number and duration of shifts required to perform abatement monitoring as part of the bid document. Costs associated with hazardous materials abatement monitoring, beyond those indicated in the Contractor's Bid, shall be deducted from Contractor's Contract Amount.

### 1.11 APPLICABLE REGULATIONS

- A. Contractor shall perform all Work in compliance with the most recent edition of all applicable federal, state, and local regulations, standards and codes governing asbestos abatement, transport, and disposal of asbestos containing/contaminated materials, lead-based/containing surface coatings and contaminated materials, Universal Waste Rule items, PCBs and all other hazardous materials.
  - 1. Requirements shall include obtaining permits, licenses, inspections, releases and similar documentation, as well as payments, statements and similar requirements associated with codes, regulations, and standards.
- B. Regulations, Standards, and Codes (General):
  - 1. General applicability of federal, state, and local regulations, standards and codes governing hazardous materials abatement, demolition, transport, and disposal, except to the extent that more explicit or more stringent requirements are written directly into the contract documents, all applicable regulations, standards, and codes have the same force and effect and are made a part of the contract documents as if copied directly into the contract documents, or as if published copies are bound herewith.
- C. Contractor Responsibility: The Contractor shall assume full responsibility and liability for the compliance with all applicable federal, state, and local regulations pertaining to work practices, transport, disposal, and protection of workers, visitors to the site, and persons occupying areas adjacent to the site.
  - 1. The contractor is responsible for providing training, medical examinations and maintaining training/medical records of personnel as required by the applicable federal, state, and local regulations, including personal air monitoring for all work practices.
  - 2. The Contractor shall hold the Owner and Project Environmental Consultant harmless for failure to comply with any applicable hazardous materials abatement, transport, disposal, safety, health or other regulation on the part of himself, his employees, or his subcontractors.

### 1.12 SUBMITTALS

- A. No later than ten days prior to commencement of work, Contractor shall submit (three copies) to the Project Environmental Consultant documentation that includes, without limitation, the following:
  - 1. **Current Copies of licenses and registrations** required by Article 1.5 Required Licensure (include copies of subcontractors' licenses).
  - 2. **Copies of written notification to the following regulatory agencies:**

- a. California Division of Occupational Safety and Health (Cal/OSHA)
  - b. South Coast Air Quality Management District (SCAQMD)
  - c. California Department of Public Health (Cal/DPH)
3. Current Proof of insurance coverage required by Article 1.8 Insurance Requirements (include proof of insurance for subcontractors).
  4. Current Proof that required permits, site location and arrangements for transport and disposal of asbestos-containing waste and other hazardous materials have been made with the appropriate disposal facility.
  5. Current Proof of legal right to use patented equipment or processes.
  6. Current Manufacturer's certification that HEPA vacuums, differential pressure air filtration devices and other HEPA-filtered local exhaust ventilation equipment conform to ANSI Z9.2-79 and have been permitted by the SCAQMD.
  7. Current Documentation showing that Contractor's employees, including foreman, supervisor, and any other company personnel or agents who may be exposed to airborne asbestos fibers or who may be responsible for any aspects of asbestos abatement activities, have received training as required by 29 CFR 1926.1101 and 8 CCR 1529.
  8. Current Documentation showing that Contractor's employees, including foreman, supervisor, and any other company personnel or agents who may be exposed to leaded dust or who may be responsible for any aspects of lead abatement activities, have received training as required by 17 CCR 35000-36100 and 8 CCR 1532.1.
  9. Current Documentation showing that Contractor's employees, including foreman, supervisor, and any other company personnel or agents who may be exposed to leaded dust or who may be responsible for any aspects of lead abatement activities, have received training as required by 17 CCR 35000-36100 and 8 CCR 1532.1.
  10. Current Documentation from Physician (signed by an M.D.) showing that all employees or agents who may be exposed to airborne asbestos fibers or leaded dust in excess of background levels have received medical monitoring to determine whether they are physically capable of working while wearing the respirator required without suffering adverse health effects. The Contractor must be aware of and provide information to the examining physician about unusual conditions in the workplace environment (e.g. high temperatures, humidity, chemical contaminants) that may impact on the employee's ability to perform work activities.
  11. Current Documentation of respirator fit-testing for all Contractor employees and agents who must enter the work area. This fit-testing shall be conducted annually and in accordance with procedures as required by 29 CFR 1910.134 and 8 CCR 5144.
  12. An emergency preparedness plan as required by Article 1.15 - Emergency Planning.

13. Master schedule, showing phasing, number of shifts, time for air clearances, tear down and manpower loading to be utilized for the duration of the project.
  14. A site specific work plan based on scope of work. Include a diagram showing containment set-up, decontamination unit(s), locations of negative air machines and exhaust placement.
- B. During abatement activities, Contractor shall submit to Project Environmental Consultant documentation that includes, without limitation, the following:
1. Copies of the work area entry/exit log book. Log book must record name, affiliation, time in, and time out for each entry into the work area.
  2. Copies of logs documenting filter changes on respirators, HEPA vacuums, differential pressure air filtration devices, water filtration device, and other engineering controls.
  3. Copies of Material Safety Data Sheets (MSDS) for solvents, encapsulants, wetting agents, replacement materials, and other substances brought by Contractor to the Project Site. MSDSs shall be available the first day that subject materials/substances are present on the project site.
  4. Results of all required OSHA compliance (personal exposure) air monitoring. Results shall be available on-site within 48 hours of completion of the last shift.
  5. Copies of all accident/incident reports where injury or damage has occurred on or to the Owner's property.
  6. Copies of daily logs indicating location(s) worked, type of materials removed, quantity of materials removed and number of personnel conducting the aforementioned activities.

### **1.13 NOTICES**

- A. Post in the clean room area of the worker decontamination enclosure a list containing the names, and telephone numbers of Owner, Construction Manager, Abatement Contractor, and Project Environmental Consultant.
- B. Post in the clean room area of the worker decontamination enclosure a list of all persons authorized to enter the work area.
- C. Additional postings shall include:
  1. Visitor Entry and Exit Log.
  2. Employee Daily Sign in Log.
  3. Entry and Exit Procedures.
  4. Emergency Procedures.

5. Copies of permits required in Article 1.6 of this document and copies of notifications required in Article 1.7 of this document.
6. As required by the Department of Labor.

#### **1.14 SITE USE AND SECURITY**

- A. Confine operations at the site to the areas permitted under the Contract. Portions of the site beyond which areas on which work is indicated are not to be disturbed. This may include noise, dust, or any other impacts.
- B. The work area shall be restricted only to authorized, trained and protected personnel, including Contractor, Contractor's employees, Owner's employees, Owner, Construction Manager, Project Environmental Consultant, and Regulatory Agency Inspectors.
- C. Entry into the work area by unauthorized individuals shall be reported immediately to the Project Environmental Consultant and Owner.
- D. Contractor shall be responsible for Project site security during abatement operations in order to protect work efforts and equipment.

#### **1.15 EMERGENCY PLANNING**

- A. Emergency planning and procedures shall be developed by Contractor prior to abatement initiation.
- B. Emergency procedures shall be in written form and prominently posted. Contractor shall ensure that all persons entering the work area read these procedures and understand the Project site layout, location of emergency exits and emergency procedures.
- C. Emergency planning shall include considerations of fire, explosion, electrical hazards, slips, trips and falls, confined spaces, school emergencies and heat related injury. Written procedures shall be developed and employee training in procedures shall be provided by Contractor.
- D. Employees shall be trained in evacuation procedures in the event of work place emergencies.
  1. For nonlife threatening situations, employees injured or otherwise incapacitated shall decontaminate following normal procedures with assistance from fellow workers, if necessary, before exiting the work place to obtain proper medical treatment.
  2. For life threatening injury or illness, worker decontamination shall take least priority. After measures to stabilize the injured worker, remove him from the work place and secure proper medical treatment.
  3. Telephone numbers of all emergency response personnel and map to closet hospital shall be prominently posted in the clean and equipment rooms.

## **1.16 FIRE PROTECTION**

- A. All plastic, spray-on strippable coatings, and structural materials used in the asbestos abatement process shall be UL-approved and certified as fire retardant or noncombustible.
- B. Wood shall be pressure impregnable and certified as fire retardant.
- C. Material Safety Data Sheets (MSDS) for fire retardant materials shall be made available upon request.
- D. All combustible rubbish and debris, including properly bagged asbestos shall be properly disposed of at the end of each working day.
- E. A minimum of one (1) 4A/60BC dry-chemical extinguisher shall be maintained at each of the following locations:
  - 1. At each corner of the work area. Where no clear corners exist, four (4) extinguishers shall be placed around the exterior wall of the work area so that they are approximately 25 percent of the total distance apart.
    - a. Exception: Where the total contained work area is less than 1,000 square feet, two (2) 4A/60BC extinguishers shall be provided. All extinguishers shall be clearly identified with red tape.
  - 2. Contractor shall ensure that on site personnel are aware of the location and proper use of all extinguishers and other fire/life safety equipment.
- F. All existing fire detection, alarm systems, connections and standpipes shall remain in place, active and unobstructed. Any alteration to this equipment must be approved by Project Environmental Consultant.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Generally, Contractor shall carefully adhere to the following:
  - 1. All plastic, spray-on strippable coatings and structural materials used shall be UL-certified as fire retardant or non-combustible.
  - 2. Deliver all materials in the original packages, containers, or bundles bearing the name of the manufacturer and brand name (where applicable).
  - 3. Fire-retardant polyethylene sheeting utilized for worker decontamination and construction/containment barriers shall be a minimum of six-mil in thickness.

4. Disposal bags shall be of six-mil polyethylene, pre-printed with labels as required by EPA regulation 40 CFR 61.152(b)(1)(iv), as well as applicable SCAQMD and Cal/OSHA requirements.
5. Stick-on labels as per EPA or Cal/OSHA requirements for disposal drums, where utilized.
6. Warning signs as required by Cal/OSHA and SCAQMD shall be utilized. Asbestos signs shall comply with both SCAQMD Rule 1403 and 8 CCR 1529, while all Lead signs shall comply with 8 CCR 1532.1.
7. Disposal drums, if utilized at the site, shall be 55-gallon DOT A1A (DOT 17H) with locking ring tops and will meet the requirements of 49 CFR 172-178.

B. Removal and Encapsulation:

1. Surfactant (wetting agent) shall be a 50/50 mixture of polyoxyethylene ether and polyoxyethylene ester, or equivalent, mixed in proportion of 1 fluid ounce to 5 gallons.
2. The encapsulating agent to be applied shall adhere to the substrate surfaces from which asbestos-containing material has been stripped.
3. The encapsulating agent shall not be flammable and should not be solvent-based or utilize a vehicle (the liquid in which the solid parts of the encapsulant are suspended) consisting of hydrocarbon.
4. If utilized, mastic removal solvents shall **NOT** be or create a RCRA waste, and shall be of the low odor variety.

C. Replacement:

1. Submit manufacturers certification indicating that replacement materials (if used) do not contain any asbestos, nor more than 90 parts per million (dry weight) of lead.

## 2.2 EQUIPMENT

A. General:

1. A sufficient quantity of HEPA vacuums and/or differential pressure air filtration devices equipped with HEPA filtration and operated in accordance with ANSI Z9.2-79 (local exhaust ventilation requirements) and EPA guidance document EPA 560/5-83-002 Guidance for Controlling Friable Asbestos Containing Materials in Buildings. To calculate total air flow requirement:

$$\text{Total ft}^3/\text{min} = \frac{\text{Vol. of work area (in ft}^3\text{)}}{15 \text{ min}}$$

To calculate the number of units needed for the abatement:

$$\text{Number of units needed} = \frac{\text{[total ft}^3/\text{min]}}{\text{[capacity of unit in ft}^3/\text{min]}}$$

2. At a minimum, full-face powered air-purifying respirators (PAPRs) with P-100 cartridges shall be utilized during all friable/Class I asbestos removal and for all removal of lead-containing paints/substances involving abrasive or mechanical removal techniques.
  3. At a minimum, half-face air-purifying respirators with P-100 cartridges shall be utilized during all lead-containing paint removal/impact except abrasive or mechanical removal, or for the removal of all non-friable/Class II asbestos removal. Where this work involves the use of solvent to remove ACM mastics, dual P100/Organic Cartridges shall be utilized.
  4. Respirators shall be furnished to the abatement workers by Contractor. The respirators shall have been tested and approved by National Institute of Occupational Safety and Health (NIOSH) for use in asbestos atmospheres.
  5. Full body disposable protective clothing, including head, body, and foot coverings shall be furnished to visitors in sizes adequate to accommodate movement without tearing.
  6. Additional safety equipment as supplied in accordance with 8 CCR 1514, (e.g. hard hats meeting the requirements of 8 CCR 1515, eye protection meeting the requirements of 8 CCR 1516, safety shoes meeting the requirements of 8 CCR 1517, hand protection meeting the requirements of 8 CCR 1520, hearing protection meeting the requirements of 8 CCR 1521 and body protection meeting the requirements of 8 CCR 1522), as necessary, shall be furnished to all workers.
  7. Non-skid foot wear shall be furnished to all abatement workers. Disposable clothing shall be adequately sealed to the footwear to prevent body contamination.
  8. Furnish a sufficient supply of disposable mops, rags, and sponges for work area decontamination.
- B. Removal:
1. A sufficient supply of scaffolds, ladders, lifts and hand tools (e.g., scrapers, wire cutters, brushes, utility knives, wire saws, etc.) shall be furnished as needed.
  2. Rubber dustpans and rubber squeegees shall be furnished for cleanup. Brooms, and any other tools associated with "dry sweeping" shall not be brought to the project site.



3. Brushes utilized for removing loose asbestos-containing material shall have nylon or fiber bristles, not metal.
  4. A sufficient supply of HEPA filtered vacuum systems shall be furnished.
- C. Encapsulation: Encapsulants shall be sprayed using airless spray equipment or hand pressurized sprayer.
- D. Enclosure: Hand tools equipped with HEPA filtered local exhaust ventilation shall be utilized during the installation of enclosures and supports if there is any need to disturb asbestos containing materials during this process. As an alternative asbestos material may be partially removed following controlled removal procedures approved by the Project Environmental Consultant.

### **PART 3 - EXECUTION**

#### **3.1 CLASS I ASBESTOS REMOVAL WORK**

The following procedures shall be utilized for all removal of friable materials and/or all Class I Asbestos Work, as well as the removal of non-friable ACM utilizing mechanical removal methods. This would include any removal of or impacts to the asbestos-containing pipe and pipe fitting insulations, at a minimum.

- A. Contractor shall coordinate all items of work with the Project Environmental Consultant and Construction Manager. Special attention shall be paid to coordination between Contractor and Construction Manager concerning scaffolding erection.
- B. Contractor shall shut down and lock out all heating, cooling, and air conditioning system (HVAC) components that pass through the work area. In the event that there is any impact to the HVAC system as it relates to service in other (remaining) buildings or areas, the HVAC system shall remain off during the project.
- C. Contractor shall shut down and lock out electric power to all Work Areas. Contractor shall provide temporary power and lighting sources, insure safe installation of temporary power sources and equipment by compliance with all applicable electrical code requirements and Cal/OSHA requirements for temporary electrical systems. Protect each circuit with a Ground Fault Circuit Interrupter (GFCI) of proper size located in the temporary panel.
- D. Install worker decontamination unit described in Article 3.8, or as agreed upon with Project Environmental Consultant.
- E. Post warning signs meeting the specifications of SCAQMD Rule 1403, 8 CCR 1529, 8 CCR 5208, and 29 CFR 1926.1101, at any location and approaches to a location where airborne concentration of asbestos fibers may exceed ambient background levels. Signs shall be posted at a distance sufficiently far enough away from a work area to permit a person to read the sign and take necessary protective measures to avoid exposure.

- F. Asbestos Handlers shall don personnel protective equipment as required in Article 2.2 - Equipment.
- G. Pre-clean all vertical and horizontal surfaces within the work area using a HEPA-filtered vacuum and/or wet cleaning techniques, as appropriate. Contractor shall not use any methods that would raise dust, such as dry sweeping or vacuuming with equipment not equipped with HEPA filters, and shall not disturb asbestos-containing materials during the pre-cleaning phase.
- H. Seal off all windows, doorways, elevator openings, corridor entrances, drains, ducts, grills, grates, diffusers, skylights and any other openings between the Work Area and uncontaminated areas outside of the Work Area with two layers six-mil fire retardant polyethylene sheeting and tape.
- I. Cover floors in the contained area, as follows:
  - 1. Two layers of six-mil (minimum) sheeting. Additional layers of sheeting may be utilized as a drop cloth to aid in cleanup of bulk materials, and/or to ensure protection from water leaks.
  - 2. Containment plastic shall be sized to minimize seams. If the floor area necessitates seams, those on successive layers of sheeting shall be staggered to reduce the potential for water to penetrate to the flooring material. A distance of at least 6 feet between seams is sufficient. Do not locate any seams at wall/floor joints.
  - 3. Floor sheeting shall extend at least 12" up the side walls of the Work Area.
  - 4. Sheeting shall be installed in a fashion so as to prevent slippage between successive layers of material.
- J. Cover all immovable items (plumbing, etc.) and/or construct walls in the Work Area with fire retardant polyethylene sheeting and seal with duct tape. Walls shall be decontaminated using HEPA vacuums and wet cleaning techniques. Walls with mortar joints (e.g., tile) are considered porous. Openings through these walls, including louvers in Mechanical Rooms, must be sealed by critical barriers.
  - 1. Walls shall be covered with two layers six-mil fire-retardant polyethylene sheeting (sealed airtight with duct tape).
  - 2. Plastic shall be sized to minimize seams. Seams shall be staggered and separated by a distance of at least six feet.
  - 3. Wall sheeting shall overlap floor sheeting by at least 12 inches beyond the wall/floor joint to provide a better seal against water damage and for negative pressure.
  - 4. Wall sheeting shall be secured adequately to prevent it from falling away from the walls. This will require additional support/attachment when Negative Pressure Ventilation Systems area utilized.

5. Where necessary for structural support, plywood sheeting and/or 2x4 lumber shall be utilized to ensure the structural integrity of the containment and critical barriers.
  6. Fire exits shall be clearly labeled as required by applicable regulations.
- K. Install the minimum number of 2' x 3' clear view windows that will provide visual access to ALL areas of each enclosure (two viewing ports, minimum).
  - L. Install and initiate operation of negative pressure air filtration as required in Article 2.2 - Equipment. Negative pressure differential shall be at a minimum of -0.02" of water column, relative to adjoining areas, at all times during asbestos removal operations.
  - M. Install and maintain a manometer equipped with a strip chart recorder. Manometer shall be capable of detecting at least 0.01" of water column.
  - N. The Contractor shall carry out all asbestos removal activities in a manner that will minimize pulverizing, breaking or creation of dust. Generally, manual removal methods will be preferred, although larger systems, such as power washers, are acceptable, as long as they are equipped with proper HEPA-filtration equipment and do not create an undue hazard.
  - O. In the event that ceilings must be demolished in order to expose the Class I ACM to be removed, any critical barriers or HVAC-related openings exposed by the ceiling demolition shall be sealed after ceiling demolition, but before ACM removal, as per Articles H and I, above.
  - P. Keep the ACM's being removed wet throughout removal operations by the use of an airless sprayer. In the event that visible dust is generated during the abatement process, also mist the air within containment periodically with water or an amended water solution with an airless sprayer to reduce airborne asbestos fiber concentrations.
  - Q. Once all removal activities have been completed, clean-up of the work areas shall be conducted in accordance with Article 3.7 - Clean-Up.
  - R. Encapsulate entire work area with a penetrating and/or lock-down type encapsulant following acceptance of clean-up activities.
  - S. Dispose of all asbestos containing/contaminated waste in accordance with Article 3.9 - Disposal Procedures.

### **3.2 CLASS II ASBESTOS REMOVAL WORK - GENERAL**

The following procedure shall be utilized for all removal of non-friable/Class II ACM, except roofing products. This type of work shall include the demolition of asbestos-containing vinyl flooring materials, mastics and asbestos cement products. Class II removal of roofing products is addressed in Article 3.3, below.

- A. Contractor shall coordinate all items of work with the Project Environmental Consultant and Construction Manager.
- B. Contractor shall shut down and lock out all heating, cooling, and air conditioning system (HVAC) components that are in supply or pass through the work area. In the event that there is any impact to the HVAC system (such as an air intake), the HVAC system shall remain off during the entirety of the project.
- C. Contractor shall shut down and lock out electric power to all Work Areas. Contractor shall provide temporary power and lighting sources, insure safe installation of temporary power sources and equipment by compliance with all applicable electrical code requirements and Cal/OSHA requirements for temporary electrical systems. Protect each circuit with a Ground Fault Circuit Interrupter (GFCI) of proper size located in the temporary panel.
- D. Install worker decontamination unit described in Article 3.8, or as agreed upon with Project Environmental Consultant.
- E. Post warning signs meeting the specifications of SCAQMD Rule 1403, 8 CCR 1529, 8 CCR 5208, and 29 CFR 1926.1101, at any location and approaches to a location where airborne concentration of asbestos fibers may exceed ambient background levels. Signs shall be posted at a distance sufficiently far enough away from a work area to permit a person to read the sign and take necessary protective measures to avoid exposure.
- F. Asbestos Handlers shall don personnel protective equipment as required in Article 2.2 - Equipment.
- G. Pre-clean all vertical and horizontal surfaces within the work area using a HEPA-filtered vacuum and/or wet cleaning techniques, as appropriate. Contractor shall not use any methods that would raise dust, such as dry sweeping or vacuuming with equipment not equipped with HEPA filters, and shall not disturb asbestos-containing materials during the pre-cleaning phase.
- H. Seal off all windows, doorways, elevator openings, corridor entrances, drains, ducts, grills, grates, diffusers, skylights and any other openings between the Work Area and uncontaminated areas outside of the Work Area with two layers six-mil fire retardant polyethylene sheeting and tape.
- I. Cover floors in the area of removal with fire retardant polyethylene sheeting (do not cover floors where asbestos-containing flooring finishes are to be removed).
  - 1. A single layer of fire retardant six-mil (minimum) sheeting. Additional layers of sheeting shall be utilized as a drop cloth to aid in cleanup of bulk materials.

2. Containment plastic shall be sized to minimize seams. If the floor area necessitates seams, those on successive layers of sheeting shall be staggered to reduce the potential for water to penetrate to the flooring material. A distance of at least 6 feet between seams is sufficient. Do not locate any seams at wall/floor joints.
  3. Floor sheeting shall extend at least 12" up the side walls of the Work Area.
  4. Sheeting shall be installed in a fashion so as to prevent slippage between successive layers of material.
- J. Cover all immovable items (plumbing, etc.) and/or construct walls in the Work Area with fire retardant polyethylene sheeting. Walls that will be demolished do not necessarily need protection (check with Project Environmental Consultant). Walls shall be decontaminated using HEPA vacuums and wet cleaning techniques. Walls with mortar joints (e.g., tile) are considered porous. Openings through these walls must be sealed by critical barriers.
1. Walls shall be covered with two layers six-mil fire-retardant polyethylene sheeting (sealed airtight with duct tape).
  2. Plastic shall be sized to minimize seams. Seams shall be staggered and separated by a distance of at least six feet.
  3. Wall sheeting shall overlap floor sheeting by at least 12 inches beyond the wall/floor joint to provide a better seal against water damage and for negative pressure.
  4. Wall sheeting shall be secured adequately to prevent it from falling away from the walls. This will require additional support/attachment when Negative Pressure Ventilation Systems area utilized.
  5. Fire exits shall be clearly labeled as required by applicable regulations.
- K. Install the minimum number of 2' x 3' clear view windows that will provide visual access to ALL areas of the enclosure.
- L. Install and initiate operation of negative pressure air filtration differential as required in Article 2.2 - Equipment. Negative pressure differential shall be at a minimum of -0.02" of water column, relative to adjoining areas, at all times during asbestos removal operations.
- M. Install and maintain a manometer equipped with a strip chart recorder. Manometer shall be capable of detecting at least 0.02" of water column.
- N. The Contractor shall carry out all asbestos removal activities in a manner that will minimize pulverizing, breaking or creation of dust. Generally, manual removal methods will be preferred, although larger systems, such as bead-blasters for mastic removal activities, are acceptable, as long as they are equipped with proper HEPA-filtration equipment.

- O. Keep the ACMs being removed wet throughout removal operations. In the event that visible dust is generated during the abatement process, also mist the air within containment periodically to reduce airborne asbestos fiber concentrations.
- P. Once all removal activities have been completed, clean-up of the work areas shall be conducted in accordance with Article 3.7 - Clean-Up.
- Q. Encapsulate entire work area with a penetrating and/or lock-down type encapsulant following acceptance of clean-up activities.
- R. Dispose of all asbestos containing/contaminated waste; debris shall be kept wet at all times and be bagged while wet in accordance with Article 3.9 - Disposal Procedures.

### **3.3 CLASS II ASBESTOS REMOVAL WORK – ROOFING PRODUCTS**

The following procedure shall be utilized for all removal of non-friable/Class II asbestos-containing roofing products, including asphaltic roofing felts and mastics. It is not anticipated that roofing products will be part of this scope, but this section is included for informational purposes, in case of scope change.

- A. Contractor shall coordinate all items of work with the Project Environmental Consultant and Construction Manager.
- B. Contractor shall shut down and lock out all heating, cooling, and air conditioning system (HVAC) components that are in supply or pass through the work area. In the event that there is any impact to the HVAC system (such as a fresh air intake), the HVAC system shall remain off during the project.
- C. Contractor shall shut down and lock out electric power to all Work Areas. Contractor shall provide temporary power and lighting sources, ensure safe installation of temporary power sources and equipment by compliance with all applicable electrical code requirements and Cal/OSHA requirements for temporary electrical systems. Protect each circuit with a Ground Fault Circuit Interrupter (GFCI) of proper size located in the temporary panel.
- D. Install worker decontamination unit described in Article 3.8 or as agreed upon with Project Environmental Consultant. If installation cannot occur on the roof, installation shall occur as close to the roof access as possible, with polyethylene sheeting laid-down between the decontamination unit and the roof access. The pathway from the regulated asbestos work area to the decontamination unit shall also be deemed part of the regulated asbestos work area, and so demarcated.
- E. Post warning signs meeting the specifications of 8 CCR 1529, 8 CCR 5208, and 29 CFR 1926.1101, at any location and approaches to a location where airborne concentration of asbestos fibers may exceed ambient background levels. Signs shall be posted at a distance sufficiently far enough away from a work area to permit a person to read the sign and take necessary protective measures to avoid exposure (generally, at roof accesses, or at least twenty feet from removal, if on roof).

- F. Asbestos Handlers shall don personnel protective equipment as required in Article 2.2. Double-suiting is recommended, if decontamination unit is not on roof.
- G. Pre-clean all vertical and horizontal surfaces within the work area using a HEPA-filtered vacuum and/or wet cleaning techniques, as appropriate. Generally, this will include roof-mounted duct work and mechanical equipment only; there is no need to pre-clean surfaces to be removed. Contractor shall not use methods that would raise dust, such as dry sweeping or vacuuming with equipment not equipped with HEPA filters, and shall not disturb asbestos-containing materials during the pre-cleaning phase.
- H. Seal off all windows, doorways, drains, ducts, skylights, roof penetrations, and any other openings between the Work Area and uncontaminated areas outside of the Work Area with six-mil fire retardant polyethylene sheeting and tape.
- I. Cover all immovable items (plumbing, etc.) and/or construct walls around immovable objects with fire-retardant polyethylene sheeting. Walls, where present, shall be decontaminated using HEPA vacuums and wet cleaning techniques. Walls with mortar joints (e.g., tile) are considered porous. Openings through these walls must be sealed by critical barriers.
1. Walls shall be covered with six-mil fire-retardant polyethylene sheeting (sealed airtight with duct tape).
  2. Plastic shall be sized to minimize seams. Seams shall be staggered and separated by a distance of at least six feet.
  3. Wall sheeting shall overlap floor sheeting by at least 12 inches beyond the wall/floor joint to provide a better seal.
  4. Wall sheeting shall be secured adequately to prevent it from falling away from the walls. This will require additional support/attachment when Negative Pressure Ventilation Systems area utilized.
  5. Fire exits shall be clearly labeled as required by applicable regulations.
- J. The Contractor shall carry out all asbestos removal activities in a manner that will minimize pulverizing, breaking or creation of dust. This may include cutting non-asbestos membrane surrounding a roof penetration, and removing the entire penetration/mastic/membrane plug as an intact piece.
- Generally, manual removal methods will be preferred for roofing products encountered on this project, although larger systems, such as mechanical shears for cutting non-asbestos membranes into strips, are acceptable, as long as they are equipped with proper shrouding and HEPA-filtration equipment.
- K. Keep the ACMs being removed wet throughout removal operations. In the event that visible dust is generated during the abatement process, also mist the air within regulated area periodically to reduce airborne asbestos fiber concentrations.

1. Bags of asbestos waste shall not be dropped or thrown from the roof, but shall be carefully lowered to the ground. Alternative systems will be considered (see Article 3.13).
- L. Once all removal activities have been completed, clean-up of the work areas shall be conducted in accordance with Article 3.7 - Clean-Up.
- M. Encapsulate entire work area with a penetrating and/or lock-down type encapsulant following acceptance of clean-up activities.
- N. Dispose of all asbestos containing/contaminated waste in accordance with Article 3.9 - Disposal Procedures.

### **3.4 PCB BULK PRODUCT REMOVAL**

The PCB Seam Caulking present on both the North side of the Central Wing to West Wing connection and the South side of the Central Wing to West Wing connection shall be removed as a PCB Bulk Product in accordance with 40 CFR 761. Disposal of such PCB Bulk Product Waste shall be disposed of in accordance with 40 CFR 761.62.

Concrete in contact with the known PCB-containing caulking that has been tested and determined to contain PCBs at concentrations of PCBs at 1.0 mg/kg or higher shall be removed as PCB Bulk Product Waste, and shall be removed at the same time as the PCB caulking.

Concrete in contact with the known PCB-containing caulking that has been tested and determined to contain PCBs at concentrations of PCBs at 1.0 mg/kg or higher, and shall remain, such as the exterior walls of the Building MM West Wing, shall be managed and encapsulated under the auspices of a USEPA-approved PCB Remediation Plan.

The soil extending three feet to the North and three feet to the East (nine square feet, total) of the North seam of the Central Wing to West Wing connection, to a depth of six inches, has been tested and determined to contain PCBs at concentrations of PCBs at 1.0 mg/kg or higher, and shall be removed, managed and disposed of under the auspices of a USEPA-approved PCB Remediation Plan.

### **3.5 LBP/LCP IMPACTS, REMOVAL & DEMOLITION**

This section applies to the removal of lead-based paints and/or the demolition of components coated with lead-based or lead-containing surface coatings, including lead-based paints, glazed porcelain plumbing fixtures, and other lead-bearing materials.

- A. Post barrier tape and warning signs meeting the specifications of 8 CCR 1532.1, 17 CCR 35000-36100, 40 CFR 745 and 29 CFR 1926.62, to demarcate regulated areas, as appropriate, and at any location and approaches to a location where airborne concentrations of lead dust may exceed ambient background levels. Signs shall be posted at a distance sufficiently far enough away from a work area to permit a person to read the sign and take necessary protective measures to avoid exposure.



- B. Prepare appropriate fall protection systems in accordance with the requirements of Title 8 California Code of Regulations, Sections 1669, 1671.2, and 1724, and anchoring guidance from Title 8 California Code of Regulations, Section 3283 (where applicable).
- C. Install worker decontamination unit described in Article 3.8, or as agreed upon with Project Environmental Consultant.
- D. Lead-containing materials (LCM) handlers involved in removal procedures shall wear two disposable Tyvek suits, including gloves, hood and footwear. Minimum respiratory protective equipment shall be half-face air-purifying respirators equipped with P100 filters. Upon exiting the work area the handlers shall HEPA vacuum all visible debris from the outer suit, dispose of it as lead-contaminated waste, and proceed through the decontamination unit for full decontamination.
- E. Isolate work area by installing critical barriers or curtained doorways across all openings where airborne lead dust migration may cause secondary lead contamination. For work where components will be removed relatively intact, such as doors, downspouts, and wood trim, drop cloths will suffice.
- F. Cover floors in each work area with fire retardant polyethylene sheeting (do not cover floors where flooring finishes, such as yellow floor striping, for example, are to be removed).
  - 1. A single layer of six-mil (minimum) sheeting.
  - 2. Containment plastic shall be sized to minimize seams.
  - 3. Where multiple layers of floor poly are utilized, sheeting shall be installed in a fashion so as to prevent slippage between successive layers of material.
- G. Cover all immovable items and/or construct walls in the Work Area with fire retardant polyethylene sheeting. Walls that will be demolished do not necessarily need protection (check with Project Environmental Consultant).
  - 1. Walls shall be covered with six-mil fire-retardant polyethylene sheeting (sealed airtight with duct tape).
  - 2. Plastic shall be sized to minimize seams.
  - 3. Wall sheeting shall overlap floor sheeting by at least 12 inches beyond the wall/floor joint to provide a better seal for negative pressure.
  - 4. Wall sheeting shall be secured adequately to prevent it from falling away from the walls. This may require additional support/attachment when Negative Pressure Ventilation Systems area utilized.
  - 5. Fire exits shall be clearly labeled with red tape or equivalent.

- H. Where manual demolition is employed for lead removal, such as ceramic tile demolition (for example), periodically mist the work area and materials to be impacted to maintain a wet condition and avoid the creation of airborne dust, which may carry lead.
- I. The Contractor shall carry out all impacts to lead-based surface coatings in a manner that will minimize pulverizing, breaking, abrading, or in any other way impacting lead-containing paints and generating airborne lead-containing dust.
- J. Once all removal activities have been completed, clean-up of the work areas shall be conducted in accordance with Article 3.7 - Clean-Up.
- K. Dispose of all lead-containing/contaminated waste in accordance with Article 3.9 - Disposal Procedures.

### 3.6 UNIVERSAL WASTE RULE IMPACTS, REFRIGERANTS, and PCBs

This section applies to the removal of all Universal Waste Rule items identified in Table 1, in Article 1.2.G.

- A. All Universal Waste Rule items shall be removed and disassembled in a non-destructive manner. All Universal Waste Rule items shall be removed intact, packaged, and disposed of in accordance with Title 22 of the California Code of Regulations, Division 4.5, et al, of the California Health and Safety Code. ***The Owner's preferred method of disposal shall be recycling.***

### 3.7 CLEAN-UP PROCEDURES

- A. Remove and containerize all visible accumulations of asbestos-containing material, lead-containing material, and asbestos/lead-contaminated debris, utilizing rubber dust pans and rubber squeegees to move material around. Do not use metal shovels to pick up or move accumulated waste within contained work areas (it tends to tear the polyethylene sheeting).

Asbestos-containing/contaminated waste shall be placed in leak tight disposal bags. Disposal bags shall be doubled six-mil polyethylene, pre-printed with labels as required by EPA regulation 40 CFR 61.152 (b) (I) (iv), Cal/OSHA (Title 8 CCR Sections 1529 and 5208), SCAQMD Rule 1403, and if applicable Title 22 CCR Division 4.5.

Lead-containing wastes shall be containerized in 55-gallon steel drums with labels as required by 8 CCR 1532.1 and 22 CCR Division 4.5.

All other hazardous wastes shall be containerized as appropriate and disposed of in a manner that satisfies the requirements for characterization and disposal set forth in 22 CCR 66243, et seq., and Sections 25157.8, et al, of the California Health and Safety Code.

- B. Whether cleaning an asbestos work area or a lead work area (or both), wet clean all surfaces in the work area utilizing rags, mops and sponges, and clean all horizontal surfaces within each work area with a HEPA-vacuum, as appropriate.

- C. Remove the cleaned layer of polyethylene sheeting from floors and walls, as applicable. Windows, doors, HVAC system vents and all other openings (critical barriers, if employed) shall remain sealed. Dispose of as asbestos-contaminated or lead-contaminated as appropriate to the work area in question.
- D. After gross cleaning of the work area, HEPA-vacuum and wet clean all objects and surfaces in the work area are completed, remove all containerized waste from the work area.
- E. Decontaminate all tools and equipment and remove at the appropriate time in the cleaning sequence.
- F. Project Environmental Consultant will inspect the work area for visible residue. If any visible accumulation of residue is observed, it will be assumed to be asbestos and/or lead, as appropriate to the work area, and a second settling period and cleaning cycle repeated at no additional cost to Owner.
- G. Following the satisfactory completion of clearance air monitoring or clearance wipe testing, the remaining barriers may be removed and prepared for proper disposal. A final visual inspection by Project Environmental Consultant will be performed. Unsatisfactory conditions, such as finding asbestos- or lead-containing debris behind the containment barriers, may require additional cleaning and air monitoring/wipe sampling, at no additional cost to Owner.

### **3.8 WORKER DECONTAMINATION SYSTEMS**

- A. Worker decontamination enclosure systems shall be provided at all locations where workers will enter or exit a regulated work area. At a minimum, one three-stage system at a single location is required for all Class I work, or for any abrasive removal processes involving lead-based paints. Lesser units may be utilized for lesser work (for instance, a two-stage decontamination unit may be utilized for Class II work). Each work area shall have a worker decontamination unit.
- B. Worker decontamination enclosure systems constructed at the Project site shall utilize six-mil, fire-retardant polyethylene sheeting, or other approved materials for privacy (generally, black polyethylene sheeting).
- C. Personnel Decontamination Units shall not be located inside a regulated work area unless specifically authorized by the Project Environmental Consultant.
- D. Alternate methods of providing Decontamination facilities may be submitted to the Project Environmental Consultant for approval. Do not proceed with any such method(s) without prior written authorization.
- E. The worker decontamination enclosure system shall consist of at least one cleansing station established in accordance with the requirements of both 8 CCR 1527 and 8 CCR 1529, equipped with adequate water, towels and cleansing agents to accommodate the entire crew and reasonable-to-anticipate visitors.

### **3.9 DISPOSAL PROCEDURES**

Contractor shall be responsible for the storage, transportation and disposal of all project-related hazardous wastes.

- A. All friable asbestos (greater than 1% asbestos) waste shall be packaged to be disposed of as Hazardous, Friable Asbestos Waste. Ensure manifest numbers are pre-printed on required asbestos waste bag labels.
- B. All non-friable asbestos (greater than 1% asbestos) waste shall be packaged to be disposed of as Non-Hazardous, Non-Friable Asbestos Waste.
- C. All lead waste shall be either disposed of as construction debris (if STLC/TCLP results allow) or lead-containing waste (with attendant RCRA codes, if TCLP results so require).
- D. All asbestos-containing waste shall be placed and stored in clear, sealed, leak-tight and appropriately labeled containers, in accordance with 8 CCR 1529 and SCAQMD Rule 1403, and transported to an appropriate landfill for disposal.
- E. All lead wastes shall be either disposed of as construction debris (if STLC/TCLP results allow) or lead-containing hazardous waste (with attendant RCRA codes, if STLC/TCLP results so require).

### **3.10 REESTABLISHMENT OF THE WORK AREAS**

- A. Reestablishment of the work area shall only occur following the completion of clean-up procedures and after clearance testing and visual inspections have been performed and documented to the satisfaction of Project Environmental Consultant.
- B. Contractor and Project Environmental Consultant shall visually inspect the work area for any remaining visible residue. Evidence of contamination will necessitate additional cleaning and air monitoring requirements at no additional cost to Owner, until approved by Project Environmental Consultant.
- C. Upon approval by Project Environmental Consultant, the Contractor shall remove remaining fire retardant polyethylene sheeting, critical barriers, and decontamination unit.
- D. Repair all areas of damage that occurred as a result of abatement activities at no additional cost to Owner, unless other arrangements and/or approvals have been provided by the Owner.

### **3.11 ENVIRONMENTAL MONITORING**

If, at any time, environmental monitoring results are in excess of allowable standards (0.01 f/cc for Asbestos; 10 micrograms per cubic meter of air for Lead), or if the Owner's Representative or Project Environmental Consultant decides work practices are violating project specifications, or applicable regulations, to the extent of potential endangerment of site users, workers, employees or public, Owner's Representative will immediately notify Contractor (followed-up in writing) that operations shall cease until corrective action is taken by Contractor. Contractor shall take such corrective action before proceeding with work. Loss or damage due to Stop Work Order(s) shall be Contractor's responsibility. A Stop Work Order, issued by Owner's Representative or Project Environmental Consultant shall become effective immediately.

Environmental monitoring shall be performed as follows:

- A. Air monitoring or wipe sampling, as appropriate, will be carried out by the Project Environmental Consultant on behalf of the Owner to verify that the building beyond the regulated contamination area remains uncontaminated.
- B. Background Air Monitoring:
  - 1. The Project Environmental Consultant may perform pre-abatement air monitoring to determine ambient fiber levels prior to abatement. The analytical method shall be the NIOSH 7400 Method.
- C. Area Air Monitoring: The Project Environmental Consultant may perform in-progress air monitoring daily to determine area airborne contaminant concentrations within the confines of the work area.
  - 1. Environmental Air Sampling: Ambient air samples are taken and analyzed to indicate fiber migration from containment to the environment. Should any environmental sample outside work areas exceed the base line of 0.01 f/cc of air, or established background concentrations as determined by PCM analysis, all work will immediately halt except for corrective work. The Project Environmental Consultant shall determine the source of the high fiber count and notify the contractor with directions for the corrective action.
- D. Clearance Air Monitoring:
  - 1. Following the completion of final clean-up operations, notify the Project Environmental Consultant that work areas are ready for final inspection and clearance air/wipe monitoring.
  - 2. Project Environmental Consultant will then sample the air/surfaces in the work area for airborne fiber concentrations.
  - 3. Phase Contrast Microscopy (PCM): In each homogeneous work area after completion of all cleaning work, a minimum number of samples will be collected and analyzed in accordance with the NIOSH 7400 Methodology as follows:

For work areas less than 160 square feet or 260 linear feet:

    - a. 5 interior aggressive air samples, 1 field blank sample and 1 lab blank sample for areas that had asbestos-containing materials removed.
    - b. Release Criteria: Decontamination of the work site is complete when each sample analyzed reveals airborne asbestos fiber concentrations are at or below 0.010 f/cc, or established background concentrations.

- c. If these conditions are not met then the decontamination is incomplete and the cleaning procedures noted in Article 3.7, above, shall be repeated. The area shall be re-tested at no additional cost to Owner until satisfactory levels are obtained.
4. Transmission Electron Microscopy (TEM): In each homogeneous work area after completion of all cleaning work, a minimum number of samples MAY be collected and analyzed by TEM in accordance with the requirements of 40 CFR Part 763, Subpart E (AHERA) as follows:

For work areas equal to or greater than 160 square feet or 260 linear feet:

- a. 5 interior aggressive air samples, 5 exterior air samples, 2 field blank samples and 1 lab blank sample for areas that had asbestos-containing materials removed.
  - b. Release Criteria: Decontamination of the work site is complete when the average of the five interior samples reveals that airborne asbestos fiber concentrations are at or below 70 structures/mm<sup>2</sup>, or established background concentrations (if comparison is going to be attempted, the classic "Z" Test shall be applied to the results of the interior versus the exterior sample results).
  - c. If these conditions are not met, decontamination shall be deemed incomplete, and the cleaning procedures noted in Article 3.7, above, shall be repeated. The area shall be re-cleaned and re-tested at no additional cost to Owner until satisfactory levels are obtained.
- E. PCB Clearance Sampling:
- 1. Following the completion of PCB remediation, wipe sampling, soil sampling and air sampling shall be performed in accordance with the USEPA-approved PCB Remediation Work Plan that shall apply to this project.

### 3.12 OSHA PERSONNEL AIR MONITORING:

- A. **Air monitoring required by OSHA is work of the contractor. The contractor is responsible for providing daily OSHA compliance monitoring as per 29 CFR 1926.1101, 8 CCR 1529 for asbestos and 29 CFR 1926.62 and 8 CCR 1532.1 for lead.**
  - 1. At minimum, Contractor shall conduct representative (25% of crew) breathing zone personal air monitoring of its employees. This shall be repeated daily, or until a "negative exposure assessment", as derived in accordance with 29 CFR 1926.1101 (f)(2)(iii) and 8 CCR 1529 for asbestos.
  - 2. Monitoring shall be conducted by a qualified air professional experienced and knowledgeable about the methods of air monitoring and in accordance with 29 CFR 1926.1101 and 8 CCR 1529.

3. Monitoring results and appropriate laboratory analysis work shall be submitted to Project Environmental Consultant **within forty-eight (48) hours of the monitoring work.**

### **3.13 ALTERNATIVE PROCEDURES**

- A. If specified procedures cannot be utilized, a request shall be made in writing to Project Environmental Consultant providing details of the problem encountered and recommended alternatives.
- B. The removal of all “other” hazardous materials shall be handled as an alternative procedure. Contractor shall submit a work plan for the removal, handling, and disposal of all “other” hazardous materials. Work described in said work plan(s) shall not commence until the work plan has been accepted and approved, in writing, by Project Environmental Consultant.
- C. Alternative procedures shall provide equivalent or greater protection than procedures that are replaced.
- D. Any alternative procedure must be approved in writing by the Project Environmental Consultant prior to the implementation of the procedure.

**End of Section 13280**

## SECTION 01 33 00 - SUBMITTAL PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

#### 1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's and Commissioning Agent's responsive action. Action submittals are those submittals indicated in individual Specification Sections as action submittals.
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Commissioning Agent's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as informational submittals.
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

#### 1.3 ACTION SUBMITTALS

- A. **Submittal Schedule:** Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Architect and additional time for handling and reviewing submittals required by those corrections.
  - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
  - 2. Initial Submittal: Submit concurrently with start-up construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
  - 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.



- a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
4. Format: Arrange the following information in a tabular format:
  - a. Scheduled date for first submittal.
  - b. Specification Section number and title.
  - c. Submittal category: Action, informational.
  - d. Name of subcontractor.
  - e. Description of the Work covered.
  - f. Scheduled date for Architect's final release or approval.
5. Architect reserves the right to withhold 10 percent of each payment request, in addition to retainage fee if any, until the submittal schedule is received and accepted by the Architect.

#### **1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS**

- A. Architect's Digital Data Files: Electronic copies of Drawings of the Contract Drawings and Project Manual will not be provided by Architect.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  2. Submit all Action and Informational submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
    - a. Exception: Where samples for initial selection and samples for verification are both required, submit samples for verification after initial selection has been returned by Architect.
  3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
  4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. Architect will document on submittal the date of receipt. Submittals received by Architect after 1:00 p.m. will be considered as received the following working day. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Duration of initial submittal review shall be as agreed upon in the final submittal schedule. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination. Delaying submittals to facilitate coordination between submittals shall not constitute a delay of the Work nor shall it be the basis for an extension of time.
  2. Sequential Review: Sequential review is a submittal that requires review by more than one design discipline. Where sequential review of submittals by Architect's consultants, Owner, or other parties is required, submittal schedule shall reflect sequential review. Sequential reviews are anticipated for, but not limited to, the following:
    - a. Division 03 Section:
      - 1) "Cast-in-Place Concrete."
    - b. Division 05 Sections:
      - 1) "Structural Steel Framing."
      - 2) "Steel Decking."
      - 3) "Cold-Formed Metal Framing."
      - 4) "Metal Fabrications."
    - c. Facility Services Subgroup Divisions: All Sections.
    - d. Site and Infrastructure Subgroup Divisions: All Sections.
  3. If intermediate submittal is necessary, process it in same manner as initial submittal.
  4. Allow 15 days for review of each resubmittal.
- D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.
    - a. Unique identifier, including revision number. Submittals shall be numbered with the Section number, followed by a dash, followed by a three-digit number, followed by a dash, and ending with a sequential submission number as indicated below. The numbering system shall be retained throughout all revisions.
      - 1) Section Number: Section number where submittal is specified.
      - 2) Three-Digit Number: Sequential number, beginning with "001," for each submittal transmitted to Architect for each Section.

- 3) Submission Number: Use "0" for initial submittal, "1" for first resubmittal, "2" for second resubmittal, and so forth.
  - 4) Example: 061000-001-0 (Section 06 10 00, first submission of the Section, initial submittal).
2. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
  3. Scanned Copies: Legible scanned PDF files of paper originals are acceptable. Scanned submittals that are not legible will be rejected.
  4. Sheet Orientation: Orient PDF sheets to a "Ready-to-Read" orientation with majority of text horizontal to the sheet with no additional adjustments or formatting required by the viewer.
  5. File Security: Do not set any permissions on the file. Protected documents will not be accepted.
  6. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software.
  7. Metadata: Include the following information in the electronic submittal file metadata:
    - a. Title: Project title
    - b. Author: Contractor's name.
    - c. Subject: Submittal type (product data, shop drawing, report, etc.)
    - d. Keywords: Number and title of appropriate Specification Section; manufacturer name; product name/model number.
  8. File Size: Limit file size of each submittal as follows. Break larger PDF files into multiple packages where necessary to meet delivery restrictions. Identify split packages as "1 of #" and "2 of #" in the subject line.
    - a. Email Delivery: 2 Megabytes.
    - b. FTP Delivery: 100 Megabytes.
- E. Options: Identify options requiring selection by Architect.
- F. Deviations and Additional Information: On an attached separate document, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
  2. Note date and content of revision in label or title block and clearly indicate extent of revision.
  3. Resubmit submittals until they are stamped with Architect's action stamp marked "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."
  4. Costs of compensation for Architect's additional services and expenses made necessary for review of submittals exceeding the limits set forth below shall be at the Contractor's expense.

- a. Reviews of Each Submittal: Two, including initial review.
- H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals with Architect's action stamp marked "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS AS NOTED."
- J. The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been reviewed by Architect and returned to Contractor with Architect's action stamp marked "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS AS NOTED."

## **PART 2 - PRODUCTS**

### **2.1 SUBMITTAL PROCEDURES**

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
  - 1. Post electronic submittals as PDF electronic files directly to Project Web site specifically established for Project. Do not post zipped files.
    - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
  - 2. Submit electronic submittals via email as PDF electronic files. Do not post zipped files.
    - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
  - 3. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 77 00 "Closeout Procedures."
  - 4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
    - a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
    - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

5. Systems Submittals: Identify submittals for systems such as fire alarms and fire protection systems, on the transmittal and act upon the system singularly as a combined submittal. If resubmission is required, resubmit entire system submittal,
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
  2. Mark each copy of each submittal to show which products and options are applicable.
  3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's written recommendations.
    - c. Manufacturer's product specifications.
    - d. Standard color charts.
    - e. Mill reports.
    - f. Standard product operating and maintenance manuals.
    - g. Compliance with recognized trade association standards.
    - h. Compliance with recognized testing agency standards.
    - i. Application of testing agency labels and seals.
    - j. Notation of coordination requirements.
    - k. Availability and delivery time information.
  4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams showing factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.
    - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  5. Submit Product Data before or concurrent with Samples.
  6. Submit Product Data in the following format:
    - a. PDF electronic file.
- C. Shop Drawings: Prepare and submit Project-specific information, drawn accurately to scale. Do not reproduce, digitally or otherwise, the Contract Documents and submit as Shop Drawings. Do not use, copy or reproduce title blocks, dimensions, notes, keynotes, symbols schedules or details from Contract Drawings, digital or otherwise. Use of the Contract Drawings shall be limited to reproduction, digitally or otherwise, of the exterior wall layout, interior partition layout, grid lines, doors, and windows. Do not base Shop Drawings on standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.

- b. Fabrication and installation drawings.
  - c. Roughing-in and setting diagrams.
  - d. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
  - e. Shopwork manufacturing instructions.
  - f. Templates and patterns.
  - g. Schedules.
  - h. Design calculations.
  - i. Compliance with specified standards.
  - j. Notation of coordination requirements.
  - k. Notation of dimensions established by field measurement.
  - l. Relationship and attachment to adjoining construction clearly indicated.
  - m. Seal and signature of professional engineer if specified.
2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than size of Contract Drawings.
  3. Submit Shop Drawings in the following format:
    - a. PDF electronic file.
- D. Samples: Submit physical units of materials or products for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  2. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
  3. Identification: Attach label on unexposed side of Samples that includes the following:
    - a. Generic description of Sample.
    - b. Product name and name of manufacturer.
    - c. Sample source.
    - d. Number and title of applicable Specification Section.
    - e. Specification paragraph number and generic name of each item.
  4. Submit corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
  5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
  - a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line.
  - b. Architect will return submittal with options selected.
  
7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
  - a. Number of Samples:
    - 1) Submit three sets of Samples.
    - 2) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
    - 3) Submit at least three sets of paired units that show approximate limits of variations if variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample.
  - b. Architect will retain one Sample set; remainder will be returned. Mark up and retain one returned Sample set as a Project record sample.
  
8. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Architect's sample where so indicated. Attach label on unexposed side that includes the following:
  - a. Generic description of Sample.
  - b. Product name or name of manufacturer.
  - c. Sample source.
  
9. Submit Samples for review of kind, color, pattern, and texture for a final check of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed.
  - a. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  - b. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.

- E. Product Schedule or List: Prepare and submit a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
  2. Manufacturer and product name, and model number if applicable.
  3. Number and name of room or space.
  4. Location within room or space.
  5. Submit product schedule in the following format:
    - a. PDF electronic file.
- F. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 29 00 "Payment Procedures."
- G. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00 "Project Management and Coordination."
- H. Subcontract List: Prepare and submit a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Submit on the form included in Document 00 60 00 "Forms," "Subcontractors and Major Material Suppliers List."
1. Submit subcontract list in the following format:
    - a. PDF electronic file.
- I. Contractor's Construction Schedule: Comply with requirements specified in Section 01 32 00 "Construction Progress Documentation" for action required.
- J. Daily Construction Reports: Comply with requirements specified in Section 01 32 00 "Construction Progress Documentation."
- K. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 40 00 "Quality Requirements."
- L. Certified Surveys: Comply with requirements specified in Section 01 73 00 "Execution."
- M. Closeout Submittals: Comply with requirements specified in Section 01 77 00 "Closeout Procedures."
- N. Operation and Maintenance Data: Submit written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Section 01 78 23 "Operation and Maintenance Data."
- O. Qualification Data: Submit written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.



- P. Welding Certificates: Prepare and submit written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- Q. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, is authorized by manufacturer for this specific Project.
- R. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.
- S. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements.
- T. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements.
- U. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
- V. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- W. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
1. Name of evaluation organization.
  2. Date of evaluation.
  3. Time period when report is in effect.
  4. Product and manufacturers' names.
  5. Description of product.
  6. Test procedures and results.
  7. Limitations of use.
- X. Preconstruction Test Reports: Prepare and submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements.
- Y. Compatibility Test Reports: Prepare and submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

- Z. Field Test Reports: Prepare and submit reports, written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements.
- AA. Manufacturer's Field Reports: Prepare and submit written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
1. Name, address, and telephone number of factory-authorized service representative making report.
  2. Statement on condition of substrates and their acceptability for installation of product.
  3. Statement that products at Project site comply with requirements.
  4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  6. Statement whether conditions, products, and installation will affect warranty.
  7. Other required items indicated in individual Specification Sections.
- BB. Manufacturer's Instructions: Submit written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
1. Preparation of substrates.
  2. Required substrate tolerances.
  3. Sequence of installation or erection.
  4. Required installation tolerances.
  5. Required adjustments.
  6. Recommendations for cleaning and protection.
- CC. Insurance Certificates and Bonds: Prepare and submit written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.
- DD. Material Maintenance Submittals: Comply with requirements specified in individual Sections for quantity and disposition of delivery of extra stock.
- EE. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

## 2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally-signed PDF electronic file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
  - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

## PART 3 - EXECUTION

### 3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Section 01 77 00 "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, coordinated, checked, and approved for compliance with the Contract Documents.

### 3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that have not been properly transmitted, reviewed by Contractor, or do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review submittal approved by Construction Manager, make marks to indicate corrections or revisions required, and return it to Contractor. Architect will stamp each submittal with an action stamp as illustrated at the end of this Section, and will mark stamp appropriately to indicate action, as follows:

1. "NO EXCEPTIONS TAKEN": No further review of Submittal required.
  2. "MAKE CORRECTIONS AS NOTED. Resubmittal not required unless Contractor cannot comply with corrections noted.": Incorporate corrections in Work. If Contractor cannot comply with corrections as noted, revise to respond to exceptions and resubmit.
  3. "REVISE AS NOTED AND RESUBMIT": Revise as noted and resubmit for further review.
  4. "RESUBMIT PROPERLY Submittal not reviewed for reasons noted."
  5. "NOT REVIEWED Submittal not required by Contract Documents.": Remove from submittal log.
  6. "RECEIVED FOR CLIENT'S RECORD ONLY. Submittal not reviewed."
- C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- F. Submittals not required by the Contract Documents will not be reviewed and may be discarded or returned marked "NOT REVIEWED."
- G. Substitution items received as product data, shop drawing, or sample submittals required by individual Sections will be returned to Contractor without review. Comply with requirements in Section 01 25 00 "Substitution Procedures" for submission of substitution request.

**END OF SECTION**

## SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
  - 1. Preconstruction photographs.
  - 2. Periodic construction photographs.
  - 3. Preconstruction videos.
  - 4. Periodic construction videos.
- B. Related Sections include the following:
  - 1. Division 1 Section "Submittal Procedures" for submitting photographic documentation.
  - 2. Division 2 Section "Selective Demolition" for photographic documentation before selective demolition operations commence.
  - 3. Division 1 Section "Demonstration and Training" for submitting videos of demonstration of equipment and training of Owner's personnel.

#### 1.3 SUBMITTALS

- A. Construction Photographs: Submit two prints of each photographic view within seven days of taking photographs.
  - 1. Format: Submit a complete set of digital image electronic files with each submittal of prints on CD-ROM, or other electronic storage device. All photos shall be uploaded to Procore within the Contractor's Photographs folder. Identify electronic media with date photographs were taken. Submit images that have same aspect ratio as the sensor, un-cropped. Pictures within the CD-ROM should have reference to the following information.
    - a. Name of Project.
    - b. Name of Construction Manager.

- c. Name of Architect.
  - d. Name of Contractor.
  - e. Date photograph was taken if not date stamped by camera.
  - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
  - g. Unique sequential identifier.
- B. Digital Video: Submit two copies of each digital video with protective sleeve or case within seven days of recording. Remove safety tab to prevent accidental re-recording.
1. Identification: On each copy, provide an applied label with the following information:
    - a. Name of Project.
    - b. Name and address of photographer.
    - c. Name of Construction Manager.
    - d. Name of Architect.
    - e. Name of Contractor.
    - f. Date video was recorded.
    - g. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
    - h. Weather conditions at time of recording.

## PART 2 - PRODUCTS

### 2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in uncompressed TIFF format, produced by a digital camera with minimum sensor size of 4.0 megapixels, and at an image resolution of not less than 1024 by 768 pixels.
- B. Digital Video Format: Provide high-quality, high definition color digital video at an image resolution of not less than 1920 x 1080 pixels.
  1. Video quality shall be adequate to create photographic prints to be made from individual frames.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Contractor shall document preconstruction conditions using photographs or video, including condition of underground utilities, as required. All site documentation photos shall be uploaded to the Contractor's Site Documentation folder within Procore.
- B. Contractor may use photographs or video.

### 3.2 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
- B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
  - 1. Date and Time: Include date and time in filename for each image.
  - 2. Field Office Images: Maintain one set of images on CD-ROM in the field office at Project site, available at all times for reference. Identify images same as for those submitted to Architect.
- C. Preconstruction Photographs: Before commencement of excavation, commencement of demolition, and starting construction, take color, digital photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as necessary to document existing conditions.
  - 1. Flag excavation areas and construction limits before taking construction photographs.
  - 2. Take photographs to show existing conditions adjacent to property before starting the Work.
  - 3. Take photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of Work.
  - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
  - 5. Show protection efforts by Contractor.
- D. Monthly Construction Photographs: Take color, digital photographs to show existing conditions uncovered as work progresses. Select vantage points to show status of construction and progress since last photographs were taken.

### 3.3 CONSTRUCTION VIDEOS

- A. Narration: Describe scenes on video by audio narration by microphone while video is recorded. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, direction (by compass point), and elevation or story of construction.
  - 1. Confirm date and time at beginning and end of recording.
  - 2. Begin each video with name of Project, Contractor's name, videographer's name, and Project location.
- B. Preconstruction Video: Before commencement of excavation, commencement of demolition, and starting construction, record video of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as necessary to document existing conditions.

1. Flag excavation areas and construction limits before recording construction videos.
  2. Show existing conditions adjacent to Project site before starting the Work.
  3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of Work.
  4. Record additional video as required to record settlement or cracking of adjacent structures, pavements, and improvements.
  5. Show protection efforts by Contractor.
- C. Monthly Construction Videos: Record video to show existing conditions uncovered as work progresses. Select vantage points to show existing construction or condition, status of construction and progress since last video was taken.

END OF SECTION 013233



## SECTION 013527 - SITE SAFETY

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

- A. Requirements for compliance with OSHA, Cal-OSHA, and other safety requirements

#### 1.02 JOBSITE SAFETY

- A. The Contractor shall be solely responsible for ensuring that all work performed under the Contract is performed in strict compliance with all applicable Federal, State and Local occupational safety regulations. The Contractor shall provide at its expense all safeguards, safety devices and protective equipment, and shall take any and all actions appropriate to providing a safe jobsite.
- B. A multi-employment worksite, as defined by Cal-OSHA, is one in which many employers occupy the same site. The Long Beach City College (LBCC) considers the Contractor to be the "controlling authority" for all work site safety and health of the sub-contractors.

#### 1.03 PROJECT SAFETY OFFICIAL (PSO)

- A. The Contractor shall designate in writing a Project Safety Official (PSO). The PSO must be a competent person capable of identifying existing and predictable hazards in the surroundings of working conditions which are unsanitary, hazardous, or dangerous to employees and must have previous experience on similar types of projects. The PSO shall be thoroughly familiar with the Contractor's INJURY AND ILLNESS PREVENTION PROGRAM (IIPP). The PSO shall be available at the work site at all times work is in progress to promptly abate any potential safety hazards and shall have the authority and responsibility to shut down an operation, if necessary. Failure by the Contractor to provide the required PSO or grant the PSO due authority are grounds upon which the BMT Construction Manager (BMT.) may direct the cessation of all work activities and operations at no cost to LBCC until such time as the Contractor is in compliance.
- B. The Contractor through the PSO shall oversee and be responsible for the provision and maintenance of, including but not limited to the following:
  - 1. A log of safety inspections performed.
  - 2. A proper and adequate First Aid kit shall be maintained on site for one time treatment of minor cuts, scratches, burns, splinters and the like.
  - 3. All applicable Material Safety Data Sheets shall be on site prior to the use of said materials.
  - 4. Display in clear view of the on-site personnel all applicable Federal, State and local regulations dealing with safety including a map denoting the route to the nearest emergency care facility with emergency phone numbers.
  - 5. Maintain an adequate Fire Protection and Prevention plan.

- a. Fire fighting equipment must be well maintained and freely accessible on site in conspicuous locations at all times.
  - b. Fire extinguishers must comply with all applicable Cal - OSHA specification.
  - c. Work shall be carried out complying with the California Fire Code, latest edition as applicable to construction work.
6. Employee Safety Training including but not limited to:
- a. All equipment operators must be trained and certified as per Contractors INJURY AND ILLNESS PREVENTION PROGRAM (IIPP):
  - b. Training in the use of fire extinguishers.
  - c. Flaggers must be trained.
  - d. Safe Scaffolding usage.
7. Lock-out and block-out procedures for machinery, equipment, electrical and tool related hazards.
8. Heavy equipment procedures and standards.
9. Excavation and trenching hazards.
10. Job site must be fenced adequately (see Section 015000-Construction Facilities and Temporary Controls) to protect Public, including gates to be kept secured at all times. In the rare cases when fences must be temporarily opened to public areas to facilitate construction or the work area can not be effectively fenced, Flaggers must be provided. Job site must be fully secured by the end of the workday with no remaining hazards or obstacles in the public areas.
- a. Flaggers must be placed in locations so as to give effective warning.
  - b. Flaggers must wear orange or strong yellow-green warning garments, such as vests, jackets, shirts, or rainwear.
11. Electrical hazards and safe procedures.
12. Musculoskeletal hazards.
13. Hazards causing chronic illness, such as exposure to lead, asbestos, and other cancer-causing products.
14. A severe weather plan including ceasing or modifying on-site operations during high temperature, lightning, or high wind velocities, etc.
15. No damaged or hazardous tools will be tolerated on site including but not limited to frayed or damaged electric cords, any tools with missing or altered original safety devices or switches, ladders without proper slip-resistant feet, etc.

16. Any work done using ladders must conform to original proper use of said ladders and all OSHA guidelines. (i.e. including but not limited to top rung of a step ladder is not to be used as a step, extension ladders must extend three rungs above the proposed use height, etc.)
  17. All employees must wear proper Personal Protective Equipment (PPE) and abide by safety work ethics included but not limited to hard hat, proper shoes, long pants, and clothing including gloves, protective eyewear and respirators, no loose clothing, long hair must be restrained, etc.
- C. Provide a site-specific written review of potential or predictable Fall Protection Hazards from heights of six (6) feet or greater. The review should address the need for Fall Protection Systems to mitigate hazards and include equipment and methods employed, responsibilities, training requirements, and monitoring methods. The erection and dismantling operations of scaffolds as well as the fall zones around scaffolds must be included as well.
1. All Fall Protection systems must be properly implemented and maintained.
  2. Fall Protection Plan must be implemented when a Fall Protection System is required but cannot be used. A Fall Protection Plan must be written by a qualified person identified in the plan and actively responsible for the implementation.
- D. Job site safety practices found by County representatives to be in violation of any of Contractors INJURY AND ILLNESS PREVENTION PROGRAM (IIPP) or applicable Federal, State and local occupational safety regulations including any Cal-OSHA issued materials shall be grounds for LBCC to direct the cessation of all work activities and operations affected by this violation at no cost to LBCC until such time as the Contractor notifies LBCC in writing that the Contractor is in compliance.
- E. Safety Indemnification. To the extent allowed by law, the Contractor agrees to defend, indemnify and hold harmless LBCC and its officers, employees and agents including PI, AOR, AOR's consultants, and BMT from and against any and all investigations, complaints, citations, liability, expense (including defense costs and legal fees), claims and/or causes of action for damages of any nature whatsoever, including but not limited to injury or death to employees of the Contractor or its subcontractors or Agency, attributable to any alleged act or omission of the Contractor or its subcontractors which is in violation of any cal/OSHA regulation. The obligation to defend, indemnify and hold harmless includes all investigations and proceedings associated with purported violations of Section 336.10 of Title 8 of the California Code of Regulations pertaining to multi-employer work sites. The Agency may deduct from any payment otherwise due the Contractor any costs incurred or anticipated to be incurred by the Agency, including legal fees and staff costs, associated with any investigation or enforcement proceeding brought by cal/OSHA arising out of the Project.

END OF SECTION 013527

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## **SECTION 01 40 00 - QUALITY REQUIREMENTS**

### **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. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-control services required by Architect, Owner, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections:
  - 1. Section 01 73 00 "Execution" for repair and restoration of construction disturbed by testing and inspecting activities.
  - 2. Divisions 02 through 49 Sections for specific test and inspection requirements.

#### **1.3 DEFINITIONS**

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect.

ADDENDUM 3 - RFI 50 - REF C.2

A: In-Place mockups are acceptable upon approval by the District. For mock-up requirements, refer to each specific section

- C. Mockups: Full-size physical assemblies that are constructed on-site, unless indicated otherwise. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
1. Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics.
  2. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
  3. Factory Mockups: Full-size physical assemblies constructed off-site, at fabrication plant.
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- K. Professional Engineer: Engineer currently licensed to practice in the State of California.

#### 1.4 CONFLICTING REQUIREMENTS

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

#### 1.5 ACTION SUBMITTALS

- A. **Shop Drawings:** For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.

- 1. Indicate manufacturer and model number of individual components.
- 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

**ADDENDUM 3 - RFI 51 REF 1.6 C**

A: Unless specifically required by DSA, this statement is not required. (Note specification reads "When required by authorities having jurisdiction....").

#### 1.6 INFORMATIONAL SUBMITTALS

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

3. Identification of applicable standards.
  4. Identification of test and inspection methods.
  5. Number of tests and inspections required.
  6. Time schedule or time span for tests and inspections.
  7. Entity responsible for performing tests and inspections.
  8. Requirements for obtaining samples.
  9. Unique characteristics of each quality-control service.
- F. Testing Agency and Inspection Reports: Prepare and submit certified written reports that include the following:
1. Date of issue.
  2. Project title and number.
  3. Name, address, and telephone number of testing agency.
  4. Dates and locations of samples and tests or inspections.
  5. Names of individuals making tests and inspections.
  6. Description of the Work and test and inspection method.
  7. Identification of product and Specification Section.
  8. Complete test or inspection data.
  9. Test and inspection results and an interpretation of test results.
  10. Ambient conditions at time of sample taking and testing and inspecting.
  11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  12. Name and signature of laboratory inspector.
  13. Recommendations on retesting and reinspecting.
- G. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
  2. Statement on condition of substrates and their acceptability for installation of product.
  3. Statement that products at Project site comply with requirements.
  4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  6. Statement whether conditions, products, and installation will affect warranty.
  7. Other required items indicated in individual Specification Sections.
- H. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
  2. Statement that equipment complies with requirements.
  3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  4. Statement whether conditions, products, and installation will affect warranty.



5. Other required items indicated in individual Specification Sections.

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

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

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

## 1.8 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Fabricator Qualifications: A firm experienced and expert in producing products similar to those indicated for this Project and with a three-year record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a three-year record of successful in-service performance.
- E. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a five-year record of successful in-service performance.
- F. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- G. Professional Engineer Qualifications: A professional engineer who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or products that are similar to those indicated for this Project in material, design, and extent.
- H. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
  - 1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.
- I. Testing Agency Qualifications: An NRTL, an NVLAP-accredited, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities..
  - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
  - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor responsibilities include the following:
    - a. Provide test specimens and assemblies representative of proposed products and construction.
    - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
    - d. Fabricate and install test assemblies and mockups using installers who will perform the same tasks for Project.
    - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
    - f. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.
  2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish specified in individual Sections, to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
  2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
  4. Demonstrate the proposed range of aesthetic effects and workmanship.
  5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
    - a. Allow seven days for initial review and each re-review of each mockup.
  6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  7. Demolish and remove mockups when directed, unless otherwise indicated.
- L. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections in Divisions 02 through 33.

- M. Factory Mockups: Construct assemblies at fabrication plant prior to shipment to the Project site as specified in individual Sections in Divisions 02 through 33.

## 1.9 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of the types of testing and inspecting they are engaged to perform.
  2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
  3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not..
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
  2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    - a. Contractor shall not employ the same entity engaged by Owner, unless agreed to in writing by Owner.
  3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
  4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
  7. Provide quality assurance and control services required due to changes in the Work proposed by or made by the Contractor.
  8. Provide quality control services for Work done contrary to the Contract Documents, without prior notice, when so specified, or without proper supervision.
  9. Overtime expenses and schedule delays accruing as a result of executing quality control services shall be the Contactor's responsibility and shall not be charged to the Owner.

### **ADDENDUM 3 - RFI 49 REF 1.9 A 2**

**A: There are no allowances on this project. Quality control of the construction project shall be conducted by the General Contractor as part of the Base Bid. District provides third party testing and inspection unless specifically noted otherwise in individual Spec Sections.**

- C. **Manufacturer's Field Services:** Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 "Submittal Procedures."
- D. **Manufacturer's Technical Services:** Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. **Retesting/Reinspecting:** Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents. Architect retains the right to require the use of a different testing agency for retesting and reinspecting.
- F. **Testing Agency Responsibilities:** Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
  6. Do not perform any duties of Contractor.
  7. Attend Project progress meetings as requested by Architect.
- G. **Associated Services:** Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
  4. Facilities for storage and field-curing of test samples.
  5. Delivery of samples to testing agencies or arranging for pick-up of test samples after normal business hours.
  6. Preliminary design mix proposed for use for material mixes that require control by testing agency.

7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
  1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit schedule concurrently with Contractor's Construction Schedule as specified in Section 01 32 00 "Construction Progress Documentation."
  1. Distribution: Distribute schedule to Owner, Architect, Commissioning Authority, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

#### **1.10 SPECIAL TESTS AND INSPECTIONS**

- A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
- B. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
  1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
  2. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority, with copy to Contractor and to authorities having jurisdiction.
  4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
  5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
  6. Retesting and reinspecting corrected work.
  7. .

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION**

**3.1 TEST AND INSPECTION LOG**

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

**3.2 REPAIR AND PROTECTION**

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

**END OF SECTION**

## SECTION 01 42 00 - REFERENCES

### PART 1 - GENERAL

#### 1.1 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 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "As Required": As required by regulatory bodies, by referenced standards, by existing conditions, by generally accepted construction practice or by the Contract Documents. In the event of ambiguity or conflicts, the most stringent requirements shall apply.
- J. "By Others" refers to work that is not a part of the Contract.



- K. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.
- L. "NIC": "Not in Contract" means the work or the item indicated is not a part of the Contract and will be provided by the Owner.
- M. "Day": Unless stated otherwise, "day" means a calendar day.

### 1.3 INDUSTRY STANDARDS

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

### 1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names and Web site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.
  - 1. AA; Aluminum Association (The); [www.aluminum.org](http://www.aluminum.org).
  - 2. AAADM; American Association of Automatic Door Manufacturers; [www.aaadm.com](http://www.aaadm.com).
  - 3. AABC; Associated Air Balance Council; [www.aabc.com](http://www.aabc.com).
  - 4. AAMA; American Architectural Manufacturers Association; [www.aamanet.org](http://www.aamanet.org).
  - 5. AAPFCO; Association of American Plant Food Control Officials; [www.aapfco.org](http://www.aapfco.org).
  - 6. AASHTO; American Association of State Highway and Transportation Officials; [www.transportation.org](http://www.transportation.org).
  - 7. AATCC; American Association of Textile Chemists and Colorists; [www.aatcc.org](http://www.aatcc.org).
  - 8. ABAA; Air Barrier Association of America; [www.airbarrier.org](http://www.airbarrier.org).
  - 9. ABMA; American Bearing Manufacturers Association; [www.americanbearings.org](http://www.americanbearings.org).
  - 10. ACI; American Concrete Institute; (Formerly: ACI International); [www.concrete.org](http://www.concrete.org).
  - 11. ACPA; American Concrete Pipe Association; [www.concrete-pipe.org](http://www.concrete-pipe.org).
  - 12. ADC; Air Diffusion Council; [www.flexibleduct.org](http://www.flexibleduct.org).

13. AEIC; Association of Edison Illuminating Companies, Inc. (The); [www.aeic.org](http://www.aeic.org).
14. AF&PA; American Forest & Paper Association; [www.afandpa.org](http://www.afandpa.org).
15. AGA; American Gas Association; [www.aga.org](http://www.aga.org).
16. AGC; Associated General Contractors of America (The); [www.agc.org](http://www.agc.org).
17. AHA; American Hardboard Association; <http://domensino.com/AHA>.
18. AHAM; Association of Home Appliance Manufacturers; [www.aham.org](http://www.aham.org).
19. AHRI; Air-Conditioning, Heating, and Refrigeration Institute (The); [www.ahrinet.org](http://www.ahrinet.org).
20. AI; Asphalt Institute; [www.asphaltinstitute.org](http://www.asphaltinstitute.org).
21. AIA; American Institute of Architects (The); [www.aia.org](http://www.aia.org).
22. AISC; American Institute of Steel Construction; [www.aisc.org](http://www.aisc.org).
23. AISI; American Iron and Steel Institute; [www.steel.org](http://www.steel.org).
24. AITC; American Institute of Timber Construction; [www.aitc-glulam.org](http://www.aitc-glulam.org).
25. ALSC; American Lumber Standard Committee, Incorporated; [www.alsc.org](http://www.alsc.org).
26. AMCA; Air Movement and Control Association International, Inc.; [www.amca.org](http://www.amca.org).
27. ANLA; American Nursery & Landscape Association; [www.anla.org](http://www.anla.org).
28. ANSI; American National Standards Institute; [www.ansi.org](http://www.ansi.org).
29. AOSA; Association of Official Seed Analysts, Inc.; [www.aosaseed.com](http://www.aosaseed.com).
30. APA; APA; The Engineered Wood Association; [www.apawood.org](http://www.apawood.org).
31. APA; Architectural Precast Association; [www.archprecast.org](http://www.archprecast.org).
32. API; American Petroleum Institute; [www.api.org](http://www.api.org).
33. APWA; American Public Works Association; [www.apwa.net](http://www.apwa.net).
34. ARI; Air-Conditioning & Refrigeration Institute; (See AHRI).
35. ARI; American Refrigeration Institute; (See AHRI).
36. ARMA; Asphalt Roofing Manufacturers Association; [www.asphaltroofing.org](http://www.asphaltroofing.org).
37. ASA; Acoustical Society of America; [www.acousticalsociety.org](http://www.acousticalsociety.org).
38. ASC; Adhesive and Sealant Council (The); [www.ascouncil.org](http://www.ascouncil.org).
39. ASCA; Architectural Spray Coaters Association.
40. ASCE; American Society of Civil Engineers; [www.asce.org](http://www.asce.org).
41. ASCE/SEI; American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
42. ASHRAE; American Society of Heating, Refrigerating and Air-Conditioning Engineers; [www.ashrae.org](http://www.ashrae.org).
43. ASME; ASME International; (American Society of Mechanical Engineers); [www.asme.org](http://www.asme.org).
44. ASPE; American Society of Plumbing Engineers; [www.aspe.org](http://www.aspe.org).
45. ASSE; American Society of Safety Engineers (The); [www.asse.org](http://www.asse.org).
46. ASSE; American Society of Sanitary Engineering; [www.asse-plumbing.org](http://www.asse-plumbing.org).
47. ASTM; ASTM International; (American Society for Testing and Materials International); [www.astm.org](http://www.astm.org).
48. ATIS; Alliance for Telecommunications Industry Solutions; [www.atis.org](http://www.atis.org).
49. ASCI; Association of the Wall and Ceiling Industry; [www.awci.org](http://www.awci.org).
50. AWEA; American Wind Energy Association; [www.awea.org](http://www.awea.org).
51. AWI; Architectural Woodwork Institute; [www.awinet.org](http://www.awinet.org).
52. AWMAC; Architectural Woodwork Manufacturers Association of Canada; [www.awmac.com](http://www.awmac.com).
53. AWWA; American Wood Protection Association; (Formerly: American Wood-Preservers' Association); [www.awpa.com](http://www.awpa.com).
54. AWS; American Welding Society; [www.aws.org](http://www.aws.org).
55. AWWA; American Water Works Association; [www.awwa.org](http://www.awwa.org).

56. BHMA; Builders Hardware Manufacturers Association; [www.buildershardware.com](http://www.buildershardware.com).
57. BIA; Brick Industry Association (The); [www.gobrick.com](http://www.gobrick.com).
58. BICSI; BICSI, Inc.; [www.bicsi.org](http://www.bicsi.org).
59. BIFMA; BIFMA International; (Business and Institutional Furniture Manufacturer's Association); [www.bifma.com](http://www.bifma.com).
60. BISSC; Baking Industry Sanitation Standards Committee; [www.bissc.org](http://www.bissc.org).
61. BWF; Badminton World Federation; (Formerly: International Badminton Federation); [www.bwfbadminton.org](http://www.bwfbadminton.org).
62. CCC; Carpet Cushion Council; [www.carpetcushion.org](http://www.carpetcushion.org).
63. CCFSS; Center for Cold-formed Steel Structures; [www.ccfsonline.org](http://www.ccfsonline.org).
64. CDA; Copper Development Association; [www.copper.org](http://www.copper.org).
65. CEA; Canadian Electricity Association; [www.electricity.ca](http://www.electricity.ca).
66. CEA; Consumer Electronics Association; [www.ce.org](http://www.ce.org).
67. CFFA; Chemical Fabrics & Film Association, Inc.; [www.chemicalfabricsandfilm.com](http://www.chemicalfabricsandfilm.com).
68. CFI; International Certified Floorcovering Installers Association; [www.cfi-installers.org](http://www.cfi-installers.org).
69. CFSEI; Cold-Formed Steel Engineers Institute; [www.cfsei.org](http://www.cfsei.org).
70. CGA; Compressed Gas Association; [www.cganet.com](http://www.cganet.com).
71. CIMA; Cellulose Insulation Manufacturers Association; [www.cellulose.org](http://www.cellulose.org).
72. CISCA; Ceilings & Interior Systems Construction Association; [www.cisca.org](http://www.cisca.org).
73. CISPI; Cast Iron Soil Pipe Institute; [www.cispi.org](http://www.cispi.org).
74. CLFMI; Chain Link Fence Manufacturers Institute; [www.chainlinkinfo.org](http://www.chainlinkinfo.org).
75. CPA; Composite Panel Association; [www.pbmdf.com](http://www.pbmdf.com).
76. CPPA; Corrugated Polyethylene Pipe Association;  
[www.plasticpipe.org/drainage/index.html](http://www.plasticpipe.org/drainage/index.html).
77. CRI; Carpet and Rug Institute (The); [www.carpet-rug.org](http://www.carpet-rug.org).
78. CRRC; Cool Roof Rating Council; [www.coolroofs.org](http://www.coolroofs.org).
79. CRSI; Concrete Reinforcing Steel Institute; [www.crsi.org](http://www.crsi.org).
80. CSA; Canadian Standards Association; [www.csa.ca](http://www.csa.ca).
81. CSA; CSA International; (Formerly: IAS; International Approval Services);  
[www.csa-international.org](http://www.csa-international.org).
82. CSI; Construction Specifications Institute (The); [www.csinet.org](http://www.csinet.org).
83. CSSB; Cedar Shake & Shingle Bureau; [www.cedarbureau.org](http://www.cedarbureau.org).
84. CTI; Cooling Technology Institute; (Formerly: Cooling Tower Institute); [www.cti.org](http://www.cti.org).
85. CWC; Composite Wood Council; (See CPA).
86. DASMA; Door and Access Systems Manufacturers Association; [www.dasma.com](http://www.dasma.com).
87. DHI; Door and Hardware Institute; [www.dhi.org](http://www.dhi.org).
88. ECA; Electronic Components Association; (See ECIA).
89. ECAMA; Electronic Components Assemblies & Materials Association; (See ECIA).
90. ECIA; Electronic Components Industry Association; [www.eciaonline.org](http://www.eciaonline.org)
91. EIA; Electronic Industries Alliance; (See TIA).
92. EIMA; EIFS Industry Members Association; [www.eima.com](http://www.eima.com).
93. EJMA; Expansion Joint Manufacturers Association, Inc.; [www.ejma.org](http://www.ejma.org).
94. ESD; ESD Association; (Electrostatic Discharge Association); [www.esda.org](http://www.esda.org).
95. ESTA; Entertainment Services and Technology Association; (See PLASA).
96. EVO; Efficiency Valuation Organization; [www.evo-world.org](http://www.evo-world.org).
97. FIBA; Federation Internationale de Basketball; (The International Basketball Federation);  
[www.fiba.com](http://www.fiba.com).
98. FIVB; Federation Internationale de Volleyball; (The International Volleyball Federation);  
[www.fivb.org](http://www.fivb.org).

99. FM Approvals; FM Approvals LLC; [www.fmglobal.com](http://www.fmglobal.com).
100. FM Global; FM Global; (Formerly: FMG; FM Global); [www.fmglobal.com](http://www.fmglobal.com).
101. FRSA; Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; [www.floridarooft.com](http://www.floridarooft.com).
102. FSA; Fluid Sealing Association; [www.fluidsealing.com](http://www.fluidsealing.com).
103. FSC; Forest Stewardship Council U.S.; [www.fscus.org](http://www.fscus.org).
104. GA; Gypsum Association; [www.gypsum.org](http://www.gypsum.org).
105. GANA; Glass Association of North America; [www.glasswebsite.com](http://www.glasswebsite.com).
106. GBCI; Green Building Certification Institute; [www.gbci.org](http://www.gbci.org).
107. GS; Green Seal; [www.greenseal.org](http://www.greenseal.org).
108. GSI; Geosynthetic Institute; [www.geosynthetic-institute.org](http://www.geosynthetic-institute.org).
109. GTA; Glass Tempering Division of Glass Association of North America; (see GANA).
110. HI; Hydraulic Institute; [www.pumps.org](http://www.pumps.org).
111. HI/GAMA; Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
112. HMMA; Hollow Metal Manufacturers Association; (See NAAMM).
113. HPVA; Hardwood Plywood & Veneer Association; [www.hpva.org](http://www.hpva.org).
114. HPW; H. P. White Laboratory, Inc.; [www.hpwhite.com](http://www.hpwhite.com).
115. IAPSC; International Association of Professional Security Consultants; [www.iapsc.org](http://www.iapsc.org).
116. IAS; International Accreditation Service; [www.iasonline.org](http://www.iasonline.org).
117. IAS; International Approval Services; (See CSA).
118. ICBO; International Conference of Building Officials; (See ICC).
119. ICC; International Code Council; [www.iccsafe.org](http://www.iccsafe.org).
120. ICEA; Insulated Cable Engineers Association, Inc.; [www.icea.net](http://www.icea.net).
121. ICPA; International Cast Polymer Alliance; [www.icpa-hq.org](http://www.icpa-hq.org).
122. ICRI; International Concrete Repair Institute, Inc.; [www.icri.org](http://www.icri.org).
123. IEC; International Electrotechnical Commission; [www.iec.ch](http://www.iec.ch).
124. IEEE; Institute of Electrical and Electronics Engineers, Inc. (The); [www.ieee.org](http://www.ieee.org).
125. IES; Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); [www.ies.org](http://www.ies.org).
126. IESNA; Illuminating Engineering Society of North America; (See IES).
127. IEST; Institute of Environmental Sciences and Technology; [www.iest.org](http://www.iest.org).
128. IGCC; Insulating Glass Certification Council; [www.igcc.org](http://www.igcc.org).
129. IGMA; Insulating Glass Manufacturers Alliance; [www.igmaonline.org](http://www.igmaonline.org).
130. IGSHPA; International Ground Source Heat Pump Association; [www.igshpa.okstate.edu](http://www.igshpa.okstate.edu).
131. ILI; Indiana Limestone Institute of America, Inc.; [www.iliai.com](http://www.iliai.com).
132. Intertek; Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); [www.intertek.com](http://www.intertek.com).
133. ISA; International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); [www.isa.org](http://www.isa.org).
134. ISAS; Instrumentation, Systems, and Automation Society (The); (See ISA).
135. ISFA; International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); [www.isfanow.org](http://www.isfanow.org).
136. ISO; International Organization for Standardization; [www.iso.org](http://www.iso.org).
137. ISSFA; International Solid Surface Fabricators Association; (See ISFA).
138. ITU; International Telecommunication Union; [www.itu.int/home](http://www.itu.int/home).
139. KCMA; Kitchen Cabinet Manufacturers Association; [www.kcma.org](http://www.kcma.org).
140. LMA; Laminating Materials Association; (See CPA).
141. LPI; Lightning Protection Institute; [www.lightning.org](http://www.lightning.org).
142. MBMA; Metal Building Manufacturers Association; [www.mbma.com](http://www.mbma.com).

143. MCA; Metal Construction Association; [www.metalconstruction.org](http://www.metalconstruction.org).
144. MFMA; Maple Flooring Manufacturers Association, Inc.; [www.maplefloor.org](http://www.maplefloor.org).
145. MFMA; Metal Framing Manufacturers Association, Inc.; [www.metalframingmfg.org](http://www.metalframingmfg.org).
146. MHIA; Material Handling Industry of America; [www.mhia.org](http://www.mhia.org).
147. MIA; Marble Institute of America; [www.marble-institute.com](http://www.marble-institute.com).
148. MIA; Masonry Institute of America; [www.masonryinstitute.org](http://www.masonryinstitute.org).
149. MMPA; Moulding & Millwork Producers Association; (Formerly: Wood Moulding & Millwork Producers Association); [www.wmmpa.com](http://www.wmmpa.com).
150. MPI; Master Painters Institute; [www.paintinfo.com](http://www.paintinfo.com).
151. MSS; Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; [www.mss-hq.org](http://www.mss-hq.org).
152. NAAMM; National Association of Architectural Metal Manufacturers; [www.naamm.org](http://www.naamm.org).
153. NACE; NACE International; (National Association of Corrosion Engineers International); [www.nace.org](http://www.nace.org).
154. NADCA; National Air Duct Cleaners Association; [www.nadca.com](http://www.nadca.com).
155. NAIMA; North American Insulation Manufacturers Association; [www.naima.org](http://www.naima.org).
156. NBGQA; National Building Granite Quarries Association, Inc.; [www.nbgqa.com](http://www.nbgqa.com).
157. NCAA; National Collegiate Athletic Association (The); [www.ncaa.org](http://www.ncaa.org).
158. NCMA; National Concrete Masonry Association; [www.ncma.org](http://www.ncma.org).
159. NCPI; National Clay Pipe Institute; [www.ncpi.org](http://www.ncpi.org).
160. NCTA; National Cable & Telecommunications Association; [www.ncta.com](http://www.ncta.com).
161. NEBB; National Environmental Balancing Bureau; [www.nebb.org](http://www.nebb.org).
162. NECA; National Electrical Contractors Association; [www.necanet.org](http://www.necanet.org).
163. NeLMA; Northeastern Lumber Manufacturers Association; [www.nelma.org](http://www.nelma.org).
164. NEMA; National Electrical Manufacturers Association; [www.nema.org](http://www.nema.org).
165. NETA; InterNational Electrical Testing Association; [www.netaworld.org](http://www.netaworld.org).
166. NFHS; National Federation of State High School Associations; [www.nfhs.org](http://www.nfhs.org).
167. NFPA; NFPA; (National Fire Protection Association); [www.nfpa.org](http://www.nfpa.org).
168. NFPA; NFPA International; (See NFPA).
169. NFRC; National Fenestration Rating Council; [www.nfrc.org](http://www.nfrc.org).
170. NGA; National Glass Association; [www.glass.org](http://www.glass.org).
171. NHLA; National Hardwood Lumber Association; [www.nhla.com](http://www.nhla.com).
172. NLGA; National Lumber Grades Authority; [www.nlga.org](http://www.nlga.org).
173. NOFMA; National Oak Flooring Manufacturers Association; (See NWFMA).
174. NOMMA; National Ornamental & Miscellaneous Metals Association; [www.nomma.org](http://www.nomma.org).
175. NRCA; National Roofing Contractors Association; [www.nrca.net](http://www.nrca.net).
176. NRMCA; National Ready Mixed Concrete Association; [www.nrmca.org](http://www.nrmca.org).
177. NSF; NSF International; (National Sanitation Foundation International); [www.nsf.org](http://www.nsf.org).
178. NSPE; National Society of Professional Engineers; [www.nspe.org](http://www.nspe.org).
179. NSSGA; National Stone, Sand & Gravel Association; [www.nssga.org](http://www.nssga.org).
180. NTMA; National Terrazzo & Mosaic Association, Inc. (The); [www.ntma.com](http://www.ntma.com).
181. NWFMA; National Wood Flooring Association; [www.nwfa.org](http://www.nwfa.org).
182. PCA; Portland Cement Association; [www.cement.org](http://www.cement.org).
183. PDCA; Painting and Decorating Contractors of America; [www.pdca.com](http://www.pdca.com).
184. PCI; Precast/Prestressed Concrete Institute; [www.pci.org](http://www.pci.org).
185. PDI; Plumbing & Drainage Institute; [www.pdionline.org](http://www.pdionline.org).
186. PGI; PVC Geomembrane Institute; <http://pgi-tp.ce.uiuc.edu>.
187. PLANET; Professional Landscape Network; [www.landcarenetwork.org](http://www.landcarenetwork.org).

188. PLASA; PLASA; (Formerly: ESTA; Entertainment Services and Technology Association); [www.plasa.org](http://www.plasa.org).
189. PTI; Post-Tensioning Institute; [www.post-tensioning.org](http://www.post-tensioning.org).
190. RCSC; Research Council on Structural Connections; [www.boltcouncil.org](http://www.boltcouncil.org).
191. RFCI; Resilient Floor Covering Institute; [www.rfci.com](http://www.rfci.com).
192. RIS; Redwood Inspection Service; [www.redwoodinspection.com](http://www.redwoodinspection.com).
193. RMA; Rubber Manufacturers Association; [www.rma.org](http://www.rma.org).
194. SAE; SAE International; (Society of Automotive Engineers); [www.sae.org](http://www.sae.org).
195. SCTE; Society of Cable Telecommunications Engineers; [www.scte.org](http://www.scte.org).
196. SDI; Steel Deck Institute; [www.sdi.org](http://www.sdi.org).
197. SDI; Steel Door Institute; [www.steeldoor.org](http://www.steeldoor.org).
198. SEFA; Scientific Equipment and Furniture Association; [www.sefalabs.com](http://www.sefalabs.com).
199. SEI/ASCE; Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
200. SGCC; Safety Glazing Certification Council; [www.sgcc.org](http://www.sgcc.org).
201. SIA; Security Industry Association; [www.siaonline.org](http://www.siaonline.org).
202. SJI; Steel Joist Institute; [www.steeljoist.org](http://www.steeljoist.org).
203. SMA; Screen Manufacturers Association; [www.smainfo.org](http://www.smainfo.org).
204. SMACNA; Sheet Metal and Air Conditioning Contractors' National Association; [www.smacna.org](http://www.smacna.org).
205. SMPTE; Society of Motion Picture and Television Engineers; [www.smpte.org](http://www.smpte.org).
206. SPFA; Spray Polyurethane Foam Alliance; [www.sprayfoam.org](http://www.sprayfoam.org).
207. SPIB; Southern Pine Inspection Bureau; [www.spib.org](http://www.spib.org).
208. SPRI; Single Ply Roofing Industry; [www.spri.org](http://www.spri.org).
209. SRCC; Solar Rating and Certification Corporation; [www.solar-rating.org](http://www.solar-rating.org).
210. SSINA; Specialty Steel Industry of North America; [www.ssina.com](http://www.ssina.com).
211. SSMA; Steel Stud Manufacturers Association; [www.ssma.com](http://www.ssma.com).
212. SSPC; SSPC: The Society for Protective Coatings; [www.sspc.org](http://www.sspc.org).
213. STI; Steel Tank Institute; [www.steeltank.com](http://www.steeltank.com).
214. SWI; Steel Window Institute; [www.steelwindows.com](http://www.steelwindows.com).
215. SWPA; Submersible Wastewater Pump Association; [www.swpa.org](http://www.swpa.org).
216. SWRI; Sealant, Waterproofing, and Restoration Institute; [www.swrionline.org](http://www.swrionline.org).
217. TCA; Tilt-Up Concrete Association; [www.tilt-up.org](http://www.tilt-up.org).
218. TCNA; Tile Council of North America, Inc.; (Formerly: Tile Council of America); [www.tileusa.com](http://www.tileusa.com).
219. TEMA; Tubular Exchanger Manufacturers Association, Inc.; [www.tema.org](http://www.tema.org).
220. TIA; Telecommunications Industry Association; (Formerly: TIA/EIA; Telecommunications Industry Association/Electronic Industries Alliance); [www.tiaonline.org](http://www.tiaonline.org).
221. TIA/EIA; Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
222. TMS; The Masonry Society; [www.masonrysociety.org](http://www.masonrysociety.org).
223. TPI; Truss Plate Institute; [www.tpinst.org](http://www.tpinst.org).
224. TPI; Turfgrass Producers International; [www.turfgrassod.org](http://www.turfgrassod.org).
225. TRI; Tile Roofing Institute; (Formerly: National Tile Roofing Manufacturing Association); [www.tilerroofing.org](http://www.tilerroofing.org).
226. UBC; Uniform Building Code; (See ICC).
227. UFAC; Upholstered Furniture Action Council; [www.ufac.org](http://www.ufac.org).
228. UL; Underwriters Laboratories Inc.; [www.ul.com](http://www.ul.com).

229. UNI; Uni-Bell PVC Pipe Association; [www.uni-bell.org](http://www.uni-bell.org).
230. USAV; USA Volleyball; [www.usavolleyball.org](http://www.usavolleyball.org).
231. USGBC; U.S. Green Building Council; [www.usgbc.org](http://www.usgbc.org).
232. USITT; United States Institute for Theatre Technology, Inc.; [www.usitt.org](http://www.usitt.org).
233. WASTEC; Waste Equipment Technology Association; [www.wastec.org](http://www.wastec.org).
234. WCLIB; West Coast Lumber Inspection Bureau; [www.wclib.org](http://www.wclib.org).
235. WCMA; Window Covering Manufacturers Association; [www.wcmanet.org](http://www.wcmanet.org).
236. WDMA; Window & Door Manufacturers Association; [www.wdma.com](http://www.wdma.com).
237. WI; Woodwork Institute; (Formerly: WIC; Woodwork Institute of California); [www.wicnet.org](http://www.wicnet.org).
238. WMMPA; Wood Moulding & Millwork Producers Association; (See MMPA).
239. WSRCA; Western States Roofing Contractors Association; [www.wsrca.com](http://www.wsrca.com).
240. WPA; Western Wood Products Association; [www.wwpa.org](http://www.wwpa.org).

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

1. DIN; Deutsches Institut für Normung e.V.; [www.din.de](http://www.din.de).
2. IAPMO; International Association of Plumbing and Mechanical Officials; [www.iapmo.org](http://www.iapmo.org).
3. ICC; International Code Council; [www.iccsafe.org](http://www.iccsafe.org).
4. ICC-ES; ICC Evaluation Service, LLC; [www.icc-es.org](http://www.icc-es.org).

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names and Web site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

1. COE; Army Corps of Engineers; [www.usace.army.mil](http://www.usace.army.mil).
2. CPSC; Consumer Product Safety Commission; [www.cpsc.gov](http://www.cpsc.gov).
3. DOC; Department of Commerce; National Institute of Standards and Technology; [www.nist.gov](http://www.nist.gov).
4. DOD; Department of Defense; <http://dodssp.daps.dla.mil>.
5. DOE; Department of Energy; [www.energy.gov](http://www.energy.gov).
6. EPA; Environmental Protection Agency; [www.epa.gov](http://www.epa.gov).
7. FAA; Federal Aviation Administration; [www.faa.gov](http://www.faa.gov).
8. FG; Federal Government Publications; [www.gpo.gov](http://www.gpo.gov).
9. GSA; General Services Administration; [www.gsa.gov](http://www.gsa.gov).
10. HUD; Department of Housing and Urban Development; [www.hud.gov](http://www.hud.gov).
11. LBL; Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; <http://eetd.lbl.gov>.
12. OSHA; Occupational Safety & Health Administration; [www.osha.gov](http://www.osha.gov).
13. SD; Department of State; [www.state.gov](http://www.state.gov).
14. TRB; Transportation Research Board; National Cooperative Highway Research Program; [www.trb.org](http://www.trb.org).
15. USDA; Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; [www.ars.usda.gov](http://www.ars.usda.gov).
16. USDA; Department of Agriculture; Rural Utilities Service; [www.usda.gov](http://www.usda.gov).

17. USDJ; Department of Justice; Office of Justice Programs; National Institute of Justice; [www.ojp.usdoj.gov](http://www.ojp.usdoj.gov).
18. USP; U.S. Pharmacopeia; [www.usp.org](http://www.usp.org).
19. USPS; United States Postal Service; [www.usps.com](http://www.usps.com).

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

1. ADAAG; Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; [www.access-board.gov](http://www.access-board.gov).
2. CFR; Code of Federal Regulations; Available from Government Printing Office; [www.gpo.gov/fdsys](http://www.gpo.gov/fdsys).
3. DOD; Department of Defense; Military Specifications and Standards; Available from Department of Defense Single Stock Point; <http://dodssp.daps.dla.mil>.
4. DSCC; Defense Supply Center Columbus; (See FS).
5. FED-STD; Federal Standard; (See FS).
6. FS; Federal Specification; Available from Department of Defense Single Stock Point; <http://dodssp.daps.dla.mil>.
  - a. Available from Defense Standardization Program; [www.dsp.dla.mil](http://www.dsp.dla.mil).
  - b. Available from General Services Administration; [www.gsa.gov](http://www.gsa.gov).
  - c. Available from National Institute of Building Sciences/Whole Building Design Guide; [www.wbdg.org/ccb](http://www.wbdg.org/ccb).
7. MILSPEC; Military Specification and Standards; (See DOD).
8. USAB; United States Access Board; [www.access-board.gov](http://www.access-board.gov).
9. USATBCB; U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names and Web site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

1. BSC; California Building Standards Commission; [www.bsc.ca.gov](http://www.bsc.ca.gov).
2. Cal/EPA; California Environmental Protection Agency; [www.calepa.ca.gov](http://www.calepa.ca.gov).
3. Cal/OSHA; California Division of Occupational Safety and Health; [www.dir.ca.gov/DOSH/dosh1.htm](http://www.dir.ca.gov/DOSH/dosh1.htm).
4. Cal/Tran; California Department of Transportation; [www.dot.ca.gov](http://www.dot.ca.gov).
5. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic Appliance and Repair, Home Furnishings and Thermal Insulation; [www.bearhfti.ca.gov](http://www.bearhfti.ca.gov).
6. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; [www.calregs.com](http://www.calregs.com).
7. CDHS; California Department of Health Services; (See CDPH).
8. CDPH; California Department of Public Health; Indoor Air Quality Program; [www.cal-iaq.org](http://www.cal-iaq.org).
9. CEC; California Energy Commission; [www.energy.ca.gov](http://www.energy.ca.gov).
10. CPUC; California Public Utilities Commission; [www.cpuc.ca.gov](http://www.cpuc.ca.gov).



11. DGS; California Department of General Services; [www.dgs.ca.gov](http://www.dgs.ca.gov).
12. DSA; California Division of State Architect; [www.dsa.dgs.ca.gov](http://www.dsa.dgs.ca.gov).
13. OSF; California Office of the State Fire Marshal; [www.osfm.fire.ca.gov](http://www.osfm.fire.ca.gov).
14. SCAQMD; South Coast Air Quality Management District; [www.aqmd.gov](http://www.aqmd.gov).

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**  
**END OF SECTION 01 42 00**

## SECTION 014213 - ABBREVIATIONS, SYMBOLS AND ACRONYMS

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

- A. List of abbreviations, symbols and acronyms used in these Specifications.

#### 1.02 ABBREVIATIONS:

OAR	Owner's Authorized Representative, I.e., Bond Management Team (BMT), Construction Manager, College Representative, Owner, Owner's representative.
AOR	Architect of Record
EOR	Engineer of Record
PM	Project Manager, OAR
IOR	Inspector of Record, Owner's Inspector, Inspector
ac	Alternating current
BTU	British thermal unit
cfh	Cubic feet per hour
cfm	Cubic feet per minute
cm	Centimeter
Co.	Company
COP	Coefficient of performance
Corp.	Corporation
d	Penny
db.	Decibel
DB	Dry bulb
dc	Direct current
EER	Energy efficiency ratio
F	Degrees Fahrenheit
fpm	Feet per minute
gph	Gallons per hour
gpm	Gallons per minute
HP	Horsepower
HVAC	Heating, ventilating and air conditioning
Hz	Hertz
Inc.	Incorporated
KHz	Kilohertz
lb	Pound
LED	Light emitting diode
MBH	1000 BTUs per hour
mfr	Manufacturer
MHz	Mega hertz
mil	Thousandth of an inch
mm	Millimeter
mph	Miles per hour
oz.	Ounce
pH	Acidity-alkalinity balance
psf	Pounds per square foot

psi	Pounds per square inch
psig	Pounds per square inch, gage
RF	Radio frequency
rpm	Revolutions per minute
V	Volt
WB	Wet bulb

1.03 SYMBOLS

#	Number
'	Foot/Feet
"	Inch(es)
%	Percent

1.04 ACRONYMS

AE	Architect and engineer(s)
ABMA	American Boiler Manufacturers Association
ABMS	American Bureau of Metal Statistics
ABPA	American Board Products Association
ACI	American Concrete Institute
AGA	American Gas Association
AHAM	Association of Heating and Air Conditioning Manufacturers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association, Inc.
ANSI	American National Standards Institute
APA	American Plywood Association
AQMD	Air Quality Management District
ARI	Air-Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Institute of America
CCR	California Code of Regulations
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CQC	California Quality Control (CMA Standards)
CRA	California Redwood Association
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standards, U.S. Department of Commerce

CTI	Ceramic Tile Institute
CTI	Cooling Tower Institute
DHI	Door and Hardware Institute
DSA	Division of the State Architect, Office of Regulation Services
DBE	Design-Build Entity, Design-Builder
FCC	Federal Communication Commission
FGMA	Flat Glass Marketing Association
FM	Factory Mutual
FS	Federal Specifications
HPMA	Hardwood Plywood Manufacturers Association
IACS	International Annealed Copper Standards
IAMPO	International Association of Plumbing and Mechanical Officials
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical & Electronic Engineers, Inc.
IES	Illuminating Engineering Society
IMI	International Masonry Institute
IRI	Industrial Risk Insurers
Mep	Mechanical, electrical, and plumbing
MIA	Marble Institute of America
MIA	Masonry Institute of America
MLSFA	Metal Lath/Steel Framing Association
MSS	Manufacturers Standardization Society of the Valve & Fittings Industry.
NAAMM	National Association of Architectural Metal Manufacturers
NBFU	National Board of Fire Underwriters
NBS	National Bureau of Standards
NCMA	National Concrete Masonry Association
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NOFMA	National Oak Flooring Manufacturers Association
NPCA	National Paint and Coatings Association
NSF	National Sanitation Foundation
NTMA	National Terrazzo & Mosaic Association
NWMA	National Woodwork Manufacturers Association
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PDI	Plumbing and Drainage Institute
PEI	Porcelain Enamel Institute
PS	Product Standard, U.S. Department of Commerce
RIS	Redwood Inspection Service
RFCI	Resilient Floor Covering Institute

SCMA	Southern Cypress Manufacturers Association
SDI	Steel Deck Institute
SFPA	Southern Forest Products Association
SIGMA	Sealed Insulating Glass Manufacturers Association
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SPIB	Southern Pine Inspection Bureau
SSPC	Steel Structure Painting Council
SWI	Steel Window Institute
TCA	Tile Council of America
UBC	Uniform Building Code
UCI	Uniform Construction Index
UL	Underwriters' Laboratories, Inc.
UMC	Uniform Mechanical Code
UPC	Uniform Plumbing Code
WCLIB	West Coast Lumber Inspection Bureau
WI (WIC)	Woodwork Institute
WWPA	Western Wood Products Association

END OF SECTION 014213

## SECTION 014523 - TESTING AND INSPECTION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 1 Specification Sections, apply to this Section.

#### 1.2 SECTION INCLUDES

- A. This Section includes the following:
  - 1. Testing and inspection services to meet requirements of the California Building Code (CBC), Title 24, Parts 1 and 2, as indicated in Contract Documents.
    - a. One or more DSA certified inspectors employed by the Owner in accordance with the requirements of California Building Standards Administrative Code will be assigned to the Work with their duties as specifically defined in Sections 4-333(b), 4-333(c), and 4-342.
  - 2. Test of materials are required by a DSA certified testing agency as set forth in Section 4-335 of the California Building Standards Administrative Code.
- B. Related Sections include the following:
  - 1. Division 1 Section "Construction Schedule".
  - 2. Division 1 Section "Submittal Procedures".
  - 3. Division 1 Section "Test and Balance".
  - 4. Division 1 Section "Construction Facilities and Temporary Controls".
  - 5. Division 1 Section "Execution Requirements".
  - 6. Division 2 Section "Selective Demolition".
  - 7. Division 1 Section "Closeout Procedures".

#### 1.3 DEFINITIONS

- A. CBC: California Building Code.
- B. DSA: State of California, Division of the State Architect.
- C. OAR: Owner's Authorized Representative(s), BMT.
- D. BMT: Bond Management Team (Construction Manager)

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 TESTS

- A. Owner will select and provide an independent testing agency to conduct tests, sampling, and testing of materials. Selection of material to be tested shall be by the agency or the BMT and not by Contractor.
  - 1. Procedural and acceptance criteria shall be as set forth in Section 4-335 of the California Building Standards Administrative Code.
  - 2. As set forth in CBC Section 1705A.1.
- B. Owner will directly reimburse testing agency all costs for all DSA required tests and inspections, but may be reimbursed by Contractor for such costs as noted in related sections of the Contract Documents.
  - 1. Contractor will reimburse Owner or directly reimburse testing agency all costs for retesting required by failed tests as set forth in Sections 4-333(c) and 4-335(c) of the California Building Standards Administrative Code.
- C. Independent testing agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.
- D. Independent testing agency shall not perform any duties of Contractor.
- E. Contractor shall notify the BMT a sufficient time in advance of the manufacture of material to be supplied by him under the Contract Documents, which must by terms of the Contract Documents be tested, in order that the Owner may arrange for the testing of same at the source of supply.
- F. Any material shipped by Contractor from source of supply prior to having satisfactorily passed such required testing and inspection or prior to receipt of notice from IOR such testing and inspection is not required shall not be incorporated into the Work.
- G. Contractor shall provide an insulated curing box with capacity for not less than twenty (20) concrete cylinders and relocate said box and cylinders as rapidly as required in order to provide for progress of the Work.

### 3.2 TEST REPORTS

- A. One copy of each test report shall be forwarded directly to DSA by the testing agency. Additional copies of each test report shall be forwarded directly to Owner, Architect, Contractor, Project Inspector, BMT, and Structural Engineer by the testing agency. Such reports shall include all tests made, regardless of whether such tests indicate that the material is satisfactory or unsatisfactory. Samples taken but not tested shall also be reported. Records of special sampling operations as required shall also be

reported. The reports shall show that the material or materials were sampled and tested in accordance with the requirements of CBC, Title 24, Parts 1 and 2, and with the approved Contract Documents. Test reports shall show the specified design strength. Test reports shall also definitely state whether or not material or materials tested comply with the specified requirements.

1. As set forth in Section 4-335(d) of the California Building Standards Administrative Code.

### 3.3 VERIFICATION OF TEST REPORTS

- A. Testing agency shall submit to DSA a verified report, in duplicate, covering tests that were performed by that agency during the progress of the Work. Additional copies of each test report shall be forwarded directly to Owner, Architect, Contractor, Project Inspector, BMT, and structural engineer by the testing agency. Such report shall be furnished each time construction on the Work is suspended, covering tests up to that time, and prior to Final Completion of the Work, covering all tests.

1. As set forth in Sections 4-335(e) and 4-336 of the California Building Standards Administrative Code.

### 3.4 INSPECTION BY OWNER

- A. Owner, and BMT shall at all times have access, for purpose of inspection, to all parts of the Work and to all shops wherein the Work is in preparation. Contractor shall at all times maintain proper facilities and provide safe access for such inspection.
- B. Owner, and BMT shall have the right to reject materials and workmanship deemed defective Work, and to require their correction. Rejected workmanship shall be corrected in a satisfactory manner and rejected materials shall be removed from the premises and legally disposed of, all without charge to Owner. If Contractor does not correct such rejected Work within a reasonable time, fixed by written notice and in accordance with the terms and conditions of the Contract Documents, Owner may correct such rejected Work and proceed in accordance with related Articles of the Contract Documents.
- C. Should it be considered necessary or advisable by the Owner and BMT at any time prior to Final Acceptance of the entire Work to make an examination of the Work already completed by removing or tearing out the same, the Contractor shall, on request, promptly furnish all necessary facilities, labor, and materials. If such work is found to be defective in any respect due to the fault of the Contractor or any of his subcontractors, he shall defray all expenses of such examinations and of satisfactory reconstruction. If, however, such work is found to meet the requirements of Contract Documents, the additional cost of labor and material necessarily involved in the examination and replacement shall be allowed the Contractor.
- D. Contractor is responsible for compliance with all applicable local, state, and federal codes, regulations, ordinances, restrictions, and requirements.



### 3.5 PROJECT INSPECTOR

- A. Project inspector, employed by the Owner in accordance with requirements of California Code of Regulations, Title 24, will be assigned to the work.
  - 1. Project inspector shall be approved by Architect, Structural Engineer, and DSA.
  - 2. As set forth in Section 4-333(b) of the California Building Standards Administrative Code.
  - 3. Duties of project inspector are specifically defined in Section 4-342 of the California Building Standards Administrative Code.
- B. The work of construction in all stages of progress shall be subject to the personal continuous observation of the project inspector. He shall have free access to any or all parts of the Work at any time. The Contractor shall furnish the project inspector reasonable facilities for obtaining such information as may be necessary to keep him fully informed respecting the progress and manner of the Work and the character of the materials.
- C. Inspection of Work shall not relieve Contractor from any obligation to fulfill all of the terms and conditions of the Contract Documents.
- D. Contractor shall be responsible for scheduling times of inspection, tests, sample taking, and similar activities of the Work.
  - 1. Contractor shall perform quality control inspection of work prior to filling out an inspection request to the inspector of record.

### 3.6 SPECIAL INSPECTOR

- A. Special Inspector:
  - 1. As set forth in Section 4-333(c) of the California Building Standards Administrative Code.
  - 2. As set forth in CBC Section 1701A.5, 1704A.1.

### 3.7 TESTS AND INSPECTIONS

- A. The following tests and inspection requirements are based on the 2013 California Building Code, Part 2 of the California Code of Regulations, Title 24, California Building Standards Code, (latest version of the International Building Code (IBC) with California Amendments).
- B. Required tests and inspections include but are not limited to the following.
  - 1. All required inspections, as applicable, shown in the California Building Code.
  - 2. All tests required per DSA 103 - Statement of Structural Tests and Special Inspections card .

3. Inspections listed within project specifications located within divisions 1 through 48.
- C. Excavations, Foundations and Retaining Walls: CBC, Chapter 18A.
  1. Inspection:
    - a. Inspection of Piles and Piers Installation: 1705A.7.1, 1810A.
- D. Concrete: CBC, Chapter 19A.
  1. Materials:
    - a. Concrete Materials: 1705A.3, 1904A.2.
    - b. Shotcrete Materials: 1705A.18, 1910A.
    - c. Portland Cement: 1903A.1, 1913A.1.
    - d. Concrete Aggregate: 1903A.6.
    - e. Shotcrete Aggregate: 1910A.3
    - f. Reinforcing Bars: 1903A.
    - g. Shotcrete Reinforcing Bars: 1910A.4.
    - h. Prestressing Steel and Anchorage: 1913A.3.
    - i. Fly Ash: 1903A.5.
  2. Quality:
    - a. Concrete Proportions: 1903A, 1904A.2.
    - b. Shotcrete Proportions: 1910A.
    - c. Concrete Testing: 1903A.
    - d. Shotcrete Testing: 1913A.5.
    - e. Mixing and Placing: 1903A.
    - f. Shotcrete Mixing and Placing: 1910A.
    - g. Curing: 1903A.
    - h. Shotcrete Curing: 1910A.9.
    - i. Cold Weather Requirements: ACI 318-11, SECTION 5.12.
    - j. Hot Weather Requirements: ACI 318-11, SECTION 5.13.
    - k. Composite Construction Cores: 1913A.4.
    - l. Gypsum Concrete Strength Tests: 1911A, 1913A.6.
    - m. Post-Installed Anchors in Concrete: 1913A.7.
  3. Inspection:
    - a. Project Site Inspection: 1903A.
    - b. Batch Plant Inspection: 1705A.3.2.
    - c. Waiver of Material Testing: 1705A.3.3.
    - d. Pre-stressed Concrete Inspection: 1705A.3.4.
    - e. Shotcrete Inspection: 1705A.18.
    - f. Reinforcing Bar Welding Inspection: 1705A.2.2.1.2.
- E. Lightweight Metal – CBC, Chapter 20A:
  1. Materials
    - a. Alloys: 2001.1

- b. Identification: 2002.1
- 2. Inspection
  - a. Welding: 2003.1
- F. Aluminum: CBC, Chapter 20:
  - 1. Materials:
    - a. Aluminum Materials: 2002.1.
  - 2. Inspection:
    - a. Aluminum Inspection: 2003.1
- G. Masonry: CBC, Chapter 21A.
  - 1. Materials:
    - a. Masonry Units: 2103A.1, 2103A.2, 2103A.4, 2103A.5, 2103A.6.
    - b. Mortar: 2103A.9, 2103A.10.
    - c. Grout: 2103A.13.
    - d. Metal Reinforcement and Accessories: 2103A.14.
  - 2. Quality:
    - a. Portland Cement Tests: 1913A.1.
    - b. Mortar and Grout Tests: 2105A.2.2.1.4.
    - c. Masonry Prism Tests: 2105A.2.2.2.
    - d. Masonry Core Tests: 2105A.5.
    - e. Combination of Units: 2105A.3.
  - 3. Inspection:
    - a. Reinforced Masonry: 1705A.4.
    - b. Reinforcing Bar Welding Inspection: 1705A.2.2.1.2.
- H. Steel: CBC, Chapter 22A.
  - 1. Materials:
    - a. Structural Steel: 2205A.1
    - b. Material Identification: 2203A.1.
  - 2. Inspection and Tests:
    - a. Test of Structural Steel: 1705A.2.
  - 3. Quality:
    - a. Test of Structural and Cold Formed Steel: 1705A.2.

- b. Tests of High Strength Bolts, Nuts, and Washers: 2213A.1.
  - c. Tests of End Welded Studs: 2213A.2.
  - d. Tests of Beam-to-Column Moment Connections: 1705A.2.
4. Inspection:
- a. Steel Construction Inspection: 1705A.2.
  - b. Shop Fabrication Inspection: 1704A.2.5.
  - c. Steel Joist and Girder Inspection: 1705A.2.2.3.
  - d. Welding Inspection: 1705A.2.2.1.
  - e. High Strength Bolt Inspection: TABLE 1705A.2.1.
  - f. Post-Installed Anchors in Concrete: 1913A.7.
  - g. Spray applied fire resistance materials: 1705A.13.
- I. Wood: CBC, Chapter 23.
1. Materials:
- a. Sawn Lumber: 2303.1.1.
  - b. Prefabricated Wood I-Joists: 2303.1.2.
  - c. Structural Glued-Laminated Timbers: 2303.1.3.
  - d. Wood Structural Panels: 2303.1.4.
  - e. Preservative Treated Wood: 2303.1.8.
  - f. Moisture Content: 2303.1.8.2.
  - g. Fire-Retardant-Treated Wood: 2303.2.
  - h. Hardwood and Plywood: 2303.3.
  - i. Wood Trusses: 2303.4.
  - j. Joist Hangers and Connectors: 2303.5.
  - k. Nails and Staples: 2303.6.
2. Inspection:
- a. Wood Construction: 1705A.5.
  - b. Glue-Laminated Fabrication: 1705A.5.4.
  - c. Timber Connectors: 1705A.5.6.
  - d. Manufactured Trusses: 1705A.5.2.
- J. Exterior Wall Coverings: CBC, Chapter 14, 25.
1. Materials:
- a. Adhered Masonry Veneer: 1405.10.
  - b. Portland Cement Plaster: 2507.1, 2507.2.
2. Inspection:
- a. Adhered Masonry Veneer Inspection: 1705A.4.1.
  - b. Portland Cement Plaster Inspection: 2503.1, 2503.2.
  - c. Exterior Insulation and Finish System (EFIS): 1705A.15.
- K. Clay or Concrete Roof Tile: CBC Chapter 15.

1. Materials:
  - a. Clay or concrete tile: 1711A.2.

END OF SECTION 014523

## **SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS**

### **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. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Sections include the following:
  - 1. Section 01 33 00 "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
  - 2. Section 01 73 00 "Execution" for progress cleaning requirements.
  - 3. Divisions 02 through 49 for temporary heat, ventilation, and humidity requirements for products in those Sections.

#### **1.3 DEFINITIONS**

- A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

#### **1.4 USE CHARGES**

- A. General: Installation and removal of and use charges for temporary facilities are not chargeable to Owner or Architect and shall be included in the Contract Sum, unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:
  - 1. Owner's construction forces.
  - 2. Occupants of Project.
  - 3. Architect.
  - 4. Commissioning Authority.
  - 5. Testing agencies.
  - 6. Personnel of authorities having jurisdiction.
- B. Sewer Service: Pay sewer service use charges for sewer usage, by all parties engaged in construction, at Project site.

- C. Water Service: Pay water service use charges, whether metered or otherwise, for water used by all entities engaged in construction activities at Project site.
- D. Electric Power Service: Pay electric power service use charges, whether metered or otherwise, for electricity used by all entities engaged in construction activities at Project site.

## **1.5 INFORMATIONAL SUBMITTALS**

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
  - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
  - 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
  - 3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
  - 1. Locations of dust-control partitions at each phase of work.
  - 2. HVAC system isolation schematic drawing.
  - 3. Location of proposed air-filtration system discharge.
  - 4. Waste handling procedures.
  - 5. Other dust-control measures.
- F. Temporary Utility Reports: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.
- G. Implementation and Termination Schedule: Within 15 days of date established for submittal of Contractor's Construction Schedule, submit a schedule indicating implementation and termination of each temporary utility.

## 1.6 QUALITY ASSURANCE

- A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.
  - 1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
  - 2. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines, and California Building Code.

## 1.7 PROJECT CONDITIONS

- A. Temporary Utilities: At earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of permanent service.
  - 1. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.
- B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
  - 1. Keep temporary services and facilities clean and neat.
  - 2. Relocate temporary services and facilities as required by progress of the Work.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Provide materials suitable for use intended.
- B. Pavement: Comply with paving Sections.
- C. Chain-Link Fencing: Minimum 2 inch, 0.148 inch thick, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8 inch OD line posts and 2-7/8 inch OD corner and pull posts, with 1-5/8 inch OD top rails.



- D. Portable Chain-Link Fencing: Minimum 2 inch, 0.148 inch thick, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8 inch OD line posts and 2-7/8 inch OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide galvanized steel bases for supporting posts.
- E. Lumber and Plywood: Comply with requirements in Section 06 10 53 "Miscellaneous Rough Carpentry."
- F. Gypsum Board: Minimum 1/2 inch thick by 48 inches wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36.
- G. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively.
- H. Paint: Comply with requirements in Section 09 91 13 "Exterior Painting" Section 09 91 23 "Interior Painting".
- I. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10 mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- J. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.
- K. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.
- L. Water: Potable.

## 2.2 TEMPORARY FACILITIES

- A. Field Offices: Prefabricated or mobile units with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, Commissioning Authority, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
  - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
  - 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no less than one receptacle on each wall. Furnish room with conference table, chairs, and 4 foot square tack and marker boards.
  - 3. Drinking water and private toilet.
  - 4. Coffee machine and supplies.
  - 5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
  - 6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
  - 1. Store combustible materials apart from building.

## 2.3 EQUIPMENT

- A. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.
  - 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
- B. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
- C. Drinking-Water Fixtures: Containerized, tap-dispenser, bottled-water drinking-water units, including paper cup supply.
  - 1. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg F.
- D. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
- E. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.
- F. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
  - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
  - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction
- G. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION, GENERAL**

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.
  - 1. Locate facilities to limit site disturbance as specified in Section 01 14 00 "Work Restrictions."
- B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

#### **3.2 TEMPORARY UTILITY INSTALLATION**

- A. General: Engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
  - 2. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services.
  - 3. Obtain easements to bring temporary utilities to Project site where Owner's easements cannot be used for that purpose.
- B. Sewers and Drainage: If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. If sewers are not available or cannot be used, provide drainage ditches, dry wells, stabilization ponds, and similar facilities. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off-site in a lawful manner.
  - 1. Filter out excessive soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.
  - 2. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
  - 3. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. After heavy use, restore normal conditions promptly.
  - 4. Provide temporary filter beds, settlement tanks, separators, and similar devices to purify effluent to levels acceptable to authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction until permanent water service is in use. Sterilize temporary water piping before use.

- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water for use of construction personnel. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.
1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
  2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Provide separate facilities for male and female personnel.
  3. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled.
    - a. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.
  4. Drinking-Water Facilities: Provide bottled-water, drinking-water units.
    - a. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg F.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed.
1. Maintain a minimum temperature of 50 deg F in permanently enclosed portions of building for normal construction activities, and 65 deg F for finishing activities and areas where finished Work has been installed.
- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- G. Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnecting means, automatic ground-fault interrupters, and main distribution switchgear.
1. Install electric power service underground, unless overhead service must be used.
  2. Install power distribution wiring overhead and rise vertically where least exposed to damage.

- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
  2. Install lighting for Project identification sign.
- I. Telephone Service: Provide temporary telephone service throughout construction period in common-use facilities used by all personnel engaged in construction activities. Install separate telephone line for each field office and first-aid station.
1. Provide additional telephone lines for the following:
    - a. In field office with more than two occupants, install a telephone for each additional occupant or pair of occupants.
    - b. Provide a separate telephone line for Owner's use.
  2. At each telephone, post a list of important telephone numbers.
    - a. Police and fire departments.
    - b. Ambulance service.
    - c. Contractor's home office and emergency after-hours telephone number.
    - d. Architect's office.
    - e. Engineers' offices.
    - f. Owner's office.
    - g. Commissioning Authority's office(s).
    - h. Principal subcontractors' field and home offices.
  3. Provide an answering machine, voice-mail service, or messaging service on superintendent's telephone.
  4. Provide a portable cellular telephone or two-way radio for superintendent's use in making and receiving telephone calls when away from field office.
- J. Internet Service: Provide computer with high-speed, broadband connection (examples: Business Class DSL, Multiple T1, Metro Ethernet), including router, equipped with hardware firewall; providing minimum 1Mbps upload and 1 Mbps download speeds for superintendent's use in sending and receiving e-mail.

### 3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.

2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
  3. Janitorial Services: Provide janitorial services on a daily basis for temporary offices, first-aid stations, toilets, wash facilities, lunchrooms, and similar areas.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate to support loads and to withstand exposure to traffic during construction period. Locate temporary roads and paved areas as indicated on Drawings.
1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Temporary Use of Permanent Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate to support loads and to withstand exposure to traffic during construction period. Locate temporary roads and paved areas in same location as permanent roads and paved areas. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
  2. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
  3. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Section 32 12 16 "Asphalt Paving."
- D. Traffic Controls: Provide temporary traffic controls at junction of temporary roads with public roads. Include warning signs for public traffic and "STOP" signs for entrance onto public roads. Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
  2. Maintain access for fire-fighting equipment and access to fire hydrants.
- E. Parking: Provide temporary parking areas for construction personnel.
- F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction and in applicable Division 31 Sections for temporary drainage and dewatering facilities and operations not directly associated with construction activities included in individual Sections. Where feasible, use same facilities. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining property nor endanger permanent Work or temporary facilities.
  2. Before connection and operation of permanent drainage piping system, provide temporary drainage where roofing or similar waterproof deck construction is completed.

- G. Project Signs: Prepare Project signs as indicated. Do not permit installation of unauthorized signs.
  - 1. Identification Signs: Provide Project identification signs as indicated on Drawings. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated.
  - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
    - a. Provide temporary, directional signs for construction personnel and visitors.
  - 3. Maintain and touchup signs so they are legible at all times.
- H. Waste Disposal Facilities: Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."
- I. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 73 00 "Execution."
  - 1. If required by authorities having jurisdiction, provide separate containers, clearly labeled, for each type of waste material to be deposited.
- J. Temporary Elevator Use: Refer to Division 14 Sections for temporary use of new elevators.
- K. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate. Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.

### **3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION**

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects
  - 1. Comply with work restrictions specified in Section 01 14 00 "Work Restrictions."
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to .
  - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.

2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
  3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
  4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Pest Control: Before deep foundation work has been completed, retain a local exterminator or pest-control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Engage this pest-control service to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- G. Site Enclosure Fence: Before construction operations begin, install site enclosure fence with lockable entrance gates. Install in a manner that will prevent people, dogs, and other animals from easily entering site except by entrance gates.
1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
  2. Provide gates in sizes and at locations necessary to accommodate delivery vehicles and other construction operations.
  3. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- H. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
- I. Barricades, Warning Signs, and Lights: Comply with authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting. Paint with appropriate colors and graphics to inform personnel and public of possible hazard.
- J. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.



1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
  2. Vertical Openings: Close openings of 25 sq. ft. or less with plywood or similar materials.
  3. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing construction.
  4. Install tarpaulins securely using fire-retardant-treated wood framing and other materials.
  5. Where temporary wood or plywood enclosure exceeds 100 sq. ft. in area, use fire-retardant-treated material for framing and main sheathing.
- L. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction area.
  2. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
    - a. Field Offices: Class A stored-pressure water-type extinguishers.
    - b. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.
    - c. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.
  3. Store combustible materials in containers in fire-safe locations.
  4. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting.
  5. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
  6. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities. Protect fire protection system from damage due to construction activities and environmental conditions.
  7. Develop and supervise an overall fire-prevention and first-aid fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
  8. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

### 3.5 MOISTURE AND MOLD CONTROL

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

### **3.6 OPERATION, TERMINATION, AND REMOVAL**

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

**END OF SECTION**

## SECTION 01 57 23 – TEMPORARY STORM WATER POLLUTION CONTROL

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Installation of Storm Water Pollution Prevention Plan (SWPPP) measures as per plans, specifications and the project SWPPP document for the purpose of preventing the discharge of pollutants from the construction site.
- B. Compliance with local, state and federal regulations.

#### 1.2 REFERENCES

- A. California Storm Water Best Management Practice Handbook for Construction Activity (BMP Handbook)
- B. Construction General Permit (CGP) Order No. 2009-009-DWQ as amended by 2010-0014-DWQ.

#### 1.3 SUBMITTAL REQUIREMENTS

- A. **Product Data:** Provide product catalog cut sheets of all temporary and permanent equipment and specialty items that will be provided to comply with the SWPPP, including items necessary for storage, disposal and recycling.
- B. **Shop Drawings:** Provide site plan indicating construction staging, storage, refuse areas and vehicular routing and parking areas.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Use materials of a class, grade and type needed to meet the performance described in the BMP Handbook and project SWPPP document.

### **PART 3 - EXECUTION**

#### **3.1 QUALIFIED SWPPP DEVELOPER (QSD)**

- A. The Owner shall designate a Qualified SWPPP Developer (QSD) having registrations, certifications and appropriate experience as defined by the State of California Construction General Permit (CGP) Order No. 2009-009-DWQ to perform the following:
1. Prepare, certify and amend as required the project SWPPP document.
  2. Assist the owner in obtaining permit coverage prior to the commencement of construction activity through filing of Permit Registration Document (PRDs) on the Storm Water Multiple Application and Report Tracking System (SMARTS).
  3. Assist the owner in filing the Notice of Termination (NOT) when construction is complete and final stabilization has been reached.

#### **3.2 QUALIFIED SWPPP PRACTITIONER (QSP)**

- A. The owner shall designate a Qualified SWPPP Practitioner (QSP) having registrations, certifications and appropriate experience as defined by the State of California Construction General Permit (CGP) Order No. 2009-009-DWQ to perform the following:
1. Conduct storm water and non-storm water visual inspections of Best Management Practices (BMPs) and prepare documentation as prescribed by the CGP according to the risk level and project type.
  2. Identifying BMP failures or shortcomings and provide an action plan to correct the deficiencies.
  3. Conduct discharge monitoring as prescribed by the CGP for pH, turbidity, and non-visible pollutant monitoring, according to the project risk level and project type.
  4. Develop a Rain Event Action Plan (REAP) for Risk Level 2 and 3 projects for qualifying rain events.
  5. Conduct pre-storm event visual inspections for qualifying rain events.
  6. Implement a Construction Site Monitoring Program (CSMP).
  7. Track weather forecasts from the National Oceanic and Atmospheric Administration (NOAA) in accordance with Permit requirements.
  8. Complete applicable monitoring, sampling, and inspection logs, forms and documents for filing to the Storm Water Multiple Application and Report Tracking System (SMARTS).
  9. Report Numeric Action Level (NAL) exceedances to SMARTS for Risk Level 2 and 3 projects.
  10. Provide assistance to the owner with annual reporting requirements.

### 3.3 PERFORMANCE BY CONTRACTOR

#### A. General

1. Keep the original SWPPP document in a readily accessible location at the construction site from the commencement of construction activity until submission of the Notice of Termination (NOT) for storm water discharges associated with construction activity. Contractors with day to day operation control over SWPPP implementation shall have the original SWPPP document available at a central location, on-site, for the use of all operators and those identified as having responsibility under the SWPPP.
2. Review the SWPPP. Ensure that all key personnel understand the requirements of the SWPPP.
3. Provide to the QSD, names of all key subcontractors involved in earthwork/land disturbing activities.

#### B. Good Site Management "Housekeeping"

1. For projects designated as Risk Level 1 and above, implement good site management (i.e., "housekeeping") measures for construction materials that could potentially be a threat to water quality if discharged. At a minimum, the contractor shall implement the following good housekeeping measures:
  - a. Conduct an inventory of the products used and/or expected to be used and the end products that are produced and/or expected to be produced. This does not include materials and equipment that are designed to be outdoors and exposed to environmental conditions (i.e. poles, equipment pads, cabinets, conductors, insulators, bricks, etc.).
  - b. Cover and berm loose stockpiled construction materials that are not actively being used (i.e. soil, spoils, aggregate, fly-ash, stucco, hydrated lime, etc.).
  - c. Store chemicals in watertight containers (with appropriate secondary containment to prevent any spillage or leakage) or in a storage shed (completely enclosed).
  - d. Minimize exposure of construction materials to precipitation. This does not include materials and equipment that are designed to be outdoors and exposed to environmental conditions (i.e. poles, equipment pads, cabinets, conductors, insulators, bricks, etc.).
  - e. Implement Best Management Practices to prevent the off-site tracking of loose construction and landscape materials.
2. For projects designated as Risk Level 1 and above, implement good housekeeping measures for waste management, which, at a minimum, shall consist of the following:
  - a. Prevent disposal of any rinse or wash waters or materials on impervious or pervious site surfaces or into the storm drain system.
  - b. Ensure the containment of sanitation facilities (e.g., portable toilets) to prevent discharges of pollutants to the storm water drainage system or receiving water.
  - c. Clean or replace sanitation facilities and inspect them regularly for leaks and spills.
  - d. Cover waste disposal containers at the end of every business day and during a rain event.
  - e. Prevent discharges from waste disposal containers to the storm water drainage system or receiving water.

- f. Contain and securely protect stockpiled waste material from wind and rain at all times unless actively being used.
- g. Implement procedures that effectively address hazardous and non-hazardous spills.
  - 1) Equipment and materials for cleanup of spills shall be available on site. Spills and leaks shall be cleaned up immediately and disposed of properly.
  - 2) Appropriate spill response personnel shall be assigned and trained.
  - 3) Ensure the containment of concrete washout areas and other washout areas that may contain additional pollutants so there is no discharge into the underlying soil and onto the surrounding areas.
- 3. For projects designated as Risk Level 1 and above, implement good housekeeping for vehicle storage and maintenance, which, at a minimum, shall consist of the following:
  - a. Prevent oil, grease, or fuel to leak in to the ground, storm drains or surface waters.
  - b. Place all equipment or vehicles, which are to be fueled, maintained and stored in a designated area fitted with appropriate Best Management Practices.
  - c. Clean leaks immediately and dispose of leaked materials properly.
- 4. For projects designated as Risk Level 1 and above, implement good housekeeping for landscape materials, which, at a minimum, shall consist of the following:
  - a. Contain stockpiled materials such as mulches and topsoil when they are not actively being used.
  - b. Contain all fertilizers and other landscape materials when they are not actively being used.
  - c. Discontinue the application of any erodible landscape material within two days before a forecasted rain event or during periods of precipitation.
  - d. Apply erodible landscape material at quantities and application rates according to manufacture recommendations or based on written specifications by knowledgeable and experienced field personnel.
  - e. Stack erodible landscape material on pallets and cover or store such materials when not being used or applied.
- 5. Maintain an inventory of materials in association with the Material Safety Data Sheet (MSDS) per OSHA requirements. Provide to QSP upon request.
- 6. For projects designated as Risk Level 1 and above, implement good housekeeping measures on the construction site to control the air deposition of site materials and from site operations. Such particulates can include, but are not limited to, sediment, nutrients, trash, metals, bacteria, oil and grease and organics.
- 7. For projects designated as Risk Level 2 or 3, implement the Rain Event Action Plan (REAP) as directed by the QSP.
- 8. For projects designated as Risk Level 1 and above, begin implementing repairs or changes to BMPs within 72 hours of identification as directed by the QSP and complete the changes as soon as possible.

#### C. Non-Storm Water Management

- 1. For projects designated as Risk Level 1 and above, implement measures to control all non-storm water discharges during construction.

2. For projects designated as Risk Level 1 and above, wash vehicles in such a manner as to prevent non-storm water discharges.
3. For projects designated as Risk Level 1 and above, clean streets in such a manner as to prevent unauthorized non-storm water discharges.

D. Erosion Control

1. For projects designated as Risk Level 1 and above, implement effective wind erosion control.
2. For projects designated as Risk Level 1 and above, provide effective soil cover for inactive areas and all finished slopes, open space, utility backfill, and completed lots.
3. For projects designated as Risk Level 1 and above, limit the use of plastic materials when more sustainable, environmentally friendly alternatives exist. Where plastic materials are deemed necessary, the discharger shall consider the use of plastic materials resistant to solar degradation.

E. Sediment Controls

1. For projects designated as Risk Level 1 and above, establish and maintain effective perimeter controls and stabilize all construction entrances and exits to sufficiently control erosion and sediment discharges from the site.
2. For projects designated as Risk Level 1 and above, on sites where sediment basins are to be used, at minimum, install and maintain sediment basins according to the method provided in CASQA's Construction BMP Guidance Handbook.
3. For projects designated as Risk Level 2 or 3, implement appropriate erosion control Best Management Practices (runoff control and soil stabilization) in conjunction with sediment control Best Management Practices for areas under active construction. Active areas of construction are areas undergoing land surface disturbances.
4. For projects designated as Risk Level 2 or 3, install linear sediment controls along the toe of the slope, face of the slope, and at the grade breaks of exposed slopes to comply with sheet flow lengths in accordance with Table 1.

Table 1 – Critical Slope/Sheet Flow Length Combinations

Slope Percentage	Sheet Flow Length Not to Exceed
0 - 25 percent	20 feet
25 - 50 percent	15 feet
Over 50 percent	10 feet

5. For projects designated as Risk Level 2 or 3, ensure that construction activity traffic to and from the project is limited to entrances and exits that employ effective controls to prevent offsite tracking of sediment.
6. For projects designated as Risk Level 2 or 3, ensure that all storm drain inlets and perimeter controls, runoff control Best Management Practices, and pollutant controls at entrances and exits (e.g. tire washoff locations) are maintained and protected from activities that reduce their effectiveness.



7. For projects designated as Risk Level 2 or 3, inspect on a daily basis all immediate access roads daily. At a minimum daily (when necessary) and prior to any rain event, remove any sediment or other construction activity related materials that are deposited on the roads (by vacuuming or sweeping).

F. Run-on and Run-off Controls

1. For projects designated as Risk Level 1 and above, effectively manage all run-on, all runoff within the site and all runoff that discharges off the site. Run-on from offsite shall be directed away from all disturbed areas or shall collectively be in compliance with the effluent limitations in this General Permit.

**END OF SECTION 01 57 23**

## **SECTION 01 60 00 - PRODUCT REQUIREMENTS**

### **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 the following administrative and procedural requirements: selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Sections:
  - 1. Section 01 25 00 "Substitution Procedures" for requests for substitutions.
  - 2. Section 01 42 00 "References" for applicable industry standards for products specified.
  - 3. Section 01 77 00 "Closeout Procedures" for submitting warranties for contract closeout.
  - 4. Divisions 03 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.

#### **1.3 DEFINITIONS**

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

- B. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
- C. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
- D. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

#### 1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
  - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
    - a. Form of Approval: As specified in Section 01 33 00 "Submittal Procedures."
    - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 33 00 "Submittal Procedures." Show compliance with requirements.

#### 1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
  - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
  - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

## 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

## 1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. **Manufacturer's Warranty:** Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
  2. **Special Warranty:** Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. **Special Warranties:** Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
1. **Manufacturer's Standard Form:** Modified to include Project-specific information and properly executed.
  2. **Specified Form:** Forms are included with the Specifications. Prepare a written document using appropriate form properly executed.
  3. Refer to Divisions 03 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.

- C. Submittal Time: Comply with requirements Section 01 77 00 "Closeout Procedures."

## **PART 2 - PRODUCTS**

### **2.1 PRODUCTS, GENERAL**

- A. Components, materials, or parts required to be supplied in quantity within a Section shall be of the same manufacture, shall be interchangeable, and shall be the same with regard to function, texture, pattern, and color.
- B. Except for building equipment in service areas, no manufacturers' labels or name plates shall be visible on any component, unless required by local authorities having jurisdiction.

### **2.2 PRODUCT SELECTION PROCEDURES**

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: Unless custom products or nonstandard options are specified, provide products of both quality and type that have been used successfully in similar situations on equal quality projects.
  3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Architect will make selection.
  5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
  6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
- B. Product Selection Procedures: Procedures for product selection include the following:
1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  3. Products:

- a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
  - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
4. Manufacturers:
- a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
  - b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
5. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Products" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
6. Visual Matching Specification: Where Specifications require matching an established Sample, provide a product (and manufacturer) that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches satisfactorily.
- a. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with requirements in Section 01 25 00 "Substitution Procedures" for proposal of product.
7. Visual Selection Specification:
- a. Standard Range: Where Specifications include the phrase "as selected by Architect from manufacturer's standard range" or similar phrase, Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that does not include premium items.
  - b. Full Range: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

### **2.3 COMPARABLE PRODUCTS**

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require extensive revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
  2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  3. Evidence that proposed product provides specified warranty.
  4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
  5. Samples, if requested.

### **PART 3 - EXECUTION (Not Used)**

**END OF SECTION**

## SECTION 016010 - MATERIALS AND EQUIPMENT

### PART 1 – GENERAL

#### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division I Specifications, apply to this Section.

#### 1.02 SUMMARY

- A. This Section includes administrative and procedural requirements governing the Contractor's selection of products for use in the Project.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 1 Section "References" specifies the applicability of industry standards to products specified.
  - 2. Division 1 Section "Submittal Procedures" and "Construction Schedule" specifies requirements for submittal of the Contractor's Construction Schedule and the Submittal Schedule.
  - 3. Division 1 Section "Substitution Procedures" specifies administrative procedures for handling requests for substitutions made after award of the Contract.

#### 1.03 DEFINITIONS

- A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry.
  - 1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
    - a. "Named Products" are items identified by the manufacture's product name, including make or model number or other designation, shown or listed in the manufacture's published product literature that is current as of the date of the Contract Documents.
  - 2. "Materials" are products substantially shaped, cut worked, mixed finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.



3. "Equipment" is a product with operation parts, whether motorized or manually operated, that requires service connections, such as wiring or piping.

#### 1.04 SUBMITTALS **Same as submittal schedule**

- A. Product List: Verify the list showing products specified in tabular form shown in the specifications, by signing and returning the Submittal Register. Include the generic names of products required. Add the manufacturer's name and proprietary product names for each item listed.
  1. Coordinate product list with the Contractor's Construction Schedule.
  2. Form: Prepare product list with the information on each item tabulated under the following column headings:
    - a. Submittal number per the submittal register.
    - b. Proprietary name, model number, and similar designations.
    - c. Manufacturer's name.
    - d. Installer's name and address.
  4. Initial Submittal: Within 15 days of the first Notice to Proceed, submit **through Procore**, one electronic copy of all required submittals. Provide a written explanation for omissions of data and for known variations from Contract requirements.
  5. ARCHITECT Action: The Architect will respond in writing to Contractor within 3 weeks of receipt of the submittals. A review constitutes no objection to listed manufacturers or products but does not constitute a waiver of the requirements that products comply with Contract Documents.

#### 1.05 QUALITY ASSURANCE

- A. Source Limitation: To the fullest extent possible, provide products of the same kind a single source.
  1. When specified product are available only from sources that do not, or cannot, produce a quantity adequate to complete project requirements in a timely manner consult with the BMT and the Architect to determine the most important product qualities before proceeding. Qualities may include attributes, such as visual appearance, strength, durability or compatibility. When a determination has been made, select products from sources producing products that possess these qualities, to the fullest extent possible.
- B. Compatibility of Option: When the Contractor is given the option of selecting between 2 or more products for use on the Project, the product selected shall be

compatible with products previously selected, even if previously selected products were also options.

1. Contractor is responsible for providing products and construction methods that are compatible with products and construction methods of other the subcontractors.
  2. If a dispute arises between subcontractors over concurrently selectable, but incompatible products, the Contractor will determine which products shall be retained and which are incompatible and must be replaced.
- C. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.
1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.
  2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:
    - a. Name of product and manufacturer
    - b. Model and serial number
    - c. Capacity
    - d. Speed
    - e. Ratings

## 1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products according to the manufacture's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.

## PART 2 – PRODUCTS

### 2.01 PRODUCT SELECTION

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, new at the time of installation.
  1. Provide products completed with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.

2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.
- B. Product Selections Procedures: The Contract Documents and governing regulations govern product selection. Procedures governing product selections include the following:
1. Proprietary Specifications Requirements: Where Specifications name only a single product or manufacturer, and indicate “no substitutions” permitted, provide the product indicated. No substitutions will be permitted.
  2. Semi Proprietary Specifications Requirements: Where Specifications name two (2) or more products or manufacturers, provide one (1) of the products indicated. No substitutions will be provided.
    - a. Where Specifications specify products or manufacturers by name accompanied by the term “or equal” or “or approved equal,” comply with the Contract Document provisions concerning “substitutions” to obtain approval for use of an unnamed product.
  3. Nonproprietary Specifications: When Specifications list products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product that complies with Contract Requirements. Comply with Contract Document provisions concerning “substitutions” to obtain approval for use of an unnamed product.
  4. Descriptive Specifications Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics. And otherwise complies with Contract requirements.
  5. Performance Specifications Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements and are recommended by the manufacturer for the application indicated.
    - a. Manufacturer’s recommendations may be contained in published product literature or by manufacturer’s certification of performance.
  6. Compliance with Standards, Codes, and Regulations: Where Specifications only required compliance with an imposed code, standard, or regulation, select a product that complies with the standards, codes, or regulations specified.
  7. Visual Matching: Where Specifications required matching an established Sample, the Architect’s decision will be final on whether a proposed product matches satisfactorily.

- a. Where no product available within the specified category matches satisfactorily and/or complies with other specified requirements, comply with provisions of the Contract Documents concerning "substitutions," for selecting the matching product in another product category.
8. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Architect will select the color, pattern, and texture from the product line selection.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION OF PRODUCTS

- A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.
  1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION 016010

## SECTION 017123 - FIELD ENGINEERING & SURVEY CONTROL

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

- A. Surveying requirements for the Work.

#### 1.02 RELATED SECTIONS

- A. Division 31: Earthwork
- B. Section 321216: Asphalt Pavement
- C. Section 334100: Storm Utility Drainage Piping
- D. Section 033000: Cast-in-Place Concrete
- E. Section 22 13 13: Sanitary Sewer

#### 1.03 WORK INCLUDED

- A. Work by Contractor under this Section shall include, but may not be limited to the following.
  - 1. Establish and maintain additional horizontal and vertical control, lines and grades as required for construction layout survey.
  - 2. Survey and measurement necessary to establish design lines and grades shown on the Construction Documents.
  - 3. Document and field verify removal of foundations and other structures to the specified elevations.
  - 4. Document foundations and new and existing utilities to remain.
  - 5. Provide a certified as-built survey based upon the field measurements of all utilities and drainage work in accordance with the State of California Business and Professional Code Sec. 6735.6.
  - 6. All maps, plans, reports, descriptions or other documents issued by the Contractor's Licensed Land Surveyor shall be stamped and signed by the Registered Professional responsible for the work.
  - 7. Land Surveyor shall provide one (1) electronic copy and one (1) hard copy of the cut sheets upon completion of staking to the Owner.

#### 1.04 SURVEY SERVICE

- A. Unless otherwise stated by the Architect or noted in the Special Provisions, the CONTRACTOR shall provide all surveying services.

- B. All surveying shall be performed by a State of California Licensed Land Surveyor or a Registered Civil Engineer authorized to practice Land Surveying in the State of California or under his/her direction in conformance with the requirements of the Professional Land Surveyors Act.

#### 1.05 QUALITY CONTROL

- A. The Contractor shall maintain a complete and accurate log of all control and survey work as it progresses.
- B. The District, or their consultants, reserves the option to check the Contractor's field survey measurements and calculations. Whether the District exercises this option or not, the Contractor shall perform accurate survey work meeting recognized industry standards.

#### 1.06 PAYMENT FOR SURVEYING

- A. The payment for surveying shall be included in respective items of work and shall include, but not to be limited to, construction staking, location and/or relocation of conflicting utilities, locating survey monuments, setting of survey monuments and center line ties, preparing and filing centerline tie sheets and Corner Records, locating Bench Marks and notifying the Office of the County Surveyor of same, professional office services and field calculations, and furnishing all labor, materials, tools, equipment and incidentals for doing all work involved. No additional compensation shall be allowed unless a separate bid item is provided.

#### PART 2 - PRODUCTS (Not applicable)

#### PART 3 - EXECUTION

##### 3.01 SUBMITTALS

- A. CONTRACTOR shall submit the name and address of the State of California licensed surveyor to BMT, ARCHITECT and OWNER including any changes as they may occur.
- B. CONTRACTOR shall submit to BMT, ARCHITECT and/or OWNER copies of cut sheets, coordinate plots, data collector printouts, and other documentation as available to verify completeness and/or accuracy of field surveying work.
- C. **Statement of Compliance:** CONTRACTOR shall submit a statement of certification signed and sealed by Surveyor, counter-signed by CONTRACTOR indicating compliance with grade elevations, slopes and tolerances.

##### 3.02 LAYOUT OF THE WORK

- A. CONTRACTOR shall employ a State of California licensed surveyor to lay out the entire Work, set grades, lines, levels, control points, vertical and horizontal

control, elevations, grids and positions. Before the commencement of Work, surveyor shall, , locate all reference points and benchmarks, then lay out all lines, elevations, and measurements for the entire Work including but not limited to, buildings, grading, paving and utilities.

- B. All work under this contract shall be built in accordance with the lines and grades shown on the plans. Field survey for establishing these, and for the control of construction, shall be the responsibility of the Contractor. All such survey work including construction staking shall be done under the supervision of a California Licensed Land Surveyor or authorized Civil Engineer. Staking shall be done on all items ordinarily requiring grade and alignment, at intervals normally accepted by the agencies and trade involved.
- C. The CONTRACTOR shall be responsible for any errors in the finished work, and shall notify the District, in writing, within 24 hours, of any discrepancies, or design errors during the construction staking.
- D. Contractor shall immediately remediate any areas found not to meet specification requirements.

### 3.03 PERMANENT SURVEY MARKERS

- A. Prior to the start of construction, the Contractor's licensed Land Surveyor or qualified Civil Engineer shall, in conformance with Section 8771 of the California State Business and Professions Code, locate all monuments (both of record and not of record), bench marks, and centerline ties within the construction zone, i.e., within one hundred feet of the construction activity. Additional ties to monuments shall be set when ties are missing (min. 4 ties per monument). The Contractor's Surveyor or qualified Civil Engineer shall prepare and submit for review to the City Engineer separate tie sheets and Corner Record sheets (monuments not of record shall have only tie sheets prepared). Corner Records shall conform to the County Engineers' Association of California's "Guide to the Preparation of Records of Survey and Corner Records" document as provided by the County Surveyor's Office. Upon review by the City Engineer, the Land Surveyor shall file the Corner Records with the County Surveyor's Office. Certified Corner Records shall be filed with the City Engineer of the City that the work is being completed in.
- B. After construction and prior to final acceptance by the Owner of the construction project, the Contractor's land surveyor or qualified Civil Engineer shall re-survey all field monuments and centerline ties within the construction zone, prepare tie sheets and Corner Record sheets as indicated above, and file them with the City Engineer for review. After review by the City Engineer, the Land Surveyor shall file the Corner Records with the County Land Surveyors Office, and file certified copies of the Corner Records with the City Engineer.
- C. All survey monuments removed or altered as a result of construction shall be reset, Corner Records filed with the County Surveyor's Office, and approved final Corner Records filed with the City Engineer. Centerline ties removed as a result of construction shall be reset and tie sheets filed with the City Engineer.

- D. The Land Surveyor shall provide a letter of certification for all monuments having four or more existing ties which are within 0.02 ft plus or minus of the original City tie sheet records. When several monuments and ties appear on one tie sheet and one of the ties has changed the Land Surveyor shall re-measure all of the ties and re-file a new tie sheet with the City as required herein.
- E. County of Los Angeles permanent and temporary bench marks within the construction zone shall be located by the surveyor, and the Contractor's Land Surveyor shall send a written notification of impending construction to the County of Los Angeles Surveyor's Office two weeks prior to construction.

### 3.04 SURVEY REQUIREMENTS

- A. Utilize a minimum of two Record Control points on the Project site, remote from the building area, referenced to data established by the survey control points.
  - 1. Re-establish the basis of bearings and benchmark as shown on the approved plans.
  - 2. All control to be tied to the basis of bearings and benchmarks.
- B. Indicate the reference points on the project record drawings with the basis of elevation being the established benchmarks.
- C. Establish lines, grades, locations and dimensions by instrumentation. From time to time, verify the layout of all Work by the same methods.
- D. Provide grade stakes and elevations to construct over excavation and re-compaction, rough and final grades, paved areas, curbs, gutters, sidewalks, building pads, landscaped areas, and other areas as required.
- E. Calculate and layout proposed finished elevations and intermediate control as required to provide smooth transitions between the spot elevations indicated in the Contract Documents.
- F. Provide stakes and elevations for grading, fill, and topsoil placement.
- G. Provide adequate horizontal and vertical control to locate utility lines, including but not limited to, storm, sewers, water mains, gas, electric and signal and provide vertical control in proportion to the slope of the line as required for accurate construction. Dry utilities will be based upon adequate horizontal and vertical control layout. Prior to trench closure, survey and record invert and flow line elevations. Survey and record top of curb and flow line elevations on finished concrete or AC surfaces at key locations such as BC's, EC's, grade breaks, corners or angle points in sufficient number to demonstrate the Work complies with the intent of the Contract Documents.
- H. Provide horizontal and vertical control for batter boards for drainage, utility, and other on-site structures as required.
- I. Furnish building corner offsets as required to adequately locate building pads. Provide cut and fill stakes within the building pad perimeter adequate to control



both over excavation and re-compaction and the final sub-grade elevation of the building pad.

- J. Submit a certification, signed by the surveyor, confirming the elevations and locations of improvements are in conformance with the Contract Documents. The statement shall include survey notes for the finish floor and building pad, showing the actual measured elevations on the completed sub-grade, recorded to the nearest 0.01'. Building pad tolerance will be +/- 0.10'.

### 3.05 ESTABLISHMENT OF GRADES IN HARDSCAPE AREAS

- A. All work shall conform to the lines, elevations, and grades shown on the Grading Plans. Three consecutive points set on the same slope shall be used together so that any variation from a straight grade can be detected. Any such variation shall be reported to the Engineer. In the absence of such report, the Contractor shall be responsible for any error in the grade of the finished work.
- B. Areas having drainage gradients of 2 percent or more shall have elevation stakes, set with instrument, at grid intervals of 25 feet. Intermediate stakes may be set by using a tightly-drawn string line over the tops of adjacent stakes. Grade stakes must be set at all grade breaks, grade changes, etc.
- C. Areas having drainage gradients of less than 2 percent shall have elevation stakes, set with instrument, at 10 foot intervals. Grade stakes must be set at all grade breaks, grade changes, etc.
- D. Protect and maintain stakes in place until their removal is approved by the Owner. Grade or location stakes lost or disturbed by Contractor, shall be reset by the Surveyor at the expense of Contractor.

### 3.06 STORM DRAIN & SANITARY SEWER PIPE INSTALLATION

- A. All storm drain pipelines, sanitary sewer pipelines, trench drains, catch basins, cleanouts and drain inlets shall be staked by a licensed surveyor if slope of grade is less than 2% and a complete set of cut sheets shall be supplied to the Inspector. All construction staking shall be installed and verified for grade and alignment prior to the start of construction.

### 3.07 UTILITY BACKFILL

- A. Prior to placing backfill, the Contractor shall perform as-built surveys based upon field measurements by the Land Surveyor to accurately record the installed depth, alignment, location of bends, valves, vaults, duct banks, manholes and all other items or conditions to provide an accurate record of all below-grade utilities. The field survey shall consist of Point number, Northing/Easting coordinates and Elevation (based on project datum), and limits of any structure, utility or other existing or new underground feature that will remain in place and be covered by the backfill.

### 3.08 RECORD DRAWINGS

- A. Upon Substantial Completion, CONTRACTOR shall obtain and pay for electronic copies (CADD and pdf) of the as built survey drawings. Deliver to BMT, ARCHITECT, final "record" drawings of the original drawings and completed Work within specified tolerances.
- B. Record drawings shall indicate locations by coordinate of all utilities onsite with top of pipe elevations at major grade and alignment changes, rim grate or top-of-curb and flow line elevations of all drainage structures and manholes.
- C. Completed record drawing shall be signed and certified as correct and within specified tolerances by the licensed surveyor.
- D. Contractor to provide one (1) hard copy and one (1) electronic CADD copy of the completed record drawings certified by the licensed surveyor.
- E. Attention is called to other sections of the Contract Documents requiring verification or measurements of installed Work by survey. Surveyor shall perform and certify all such surveys or verification are completed in accordance with the Contract Documents.

END OF SECTION 017123

## **SECTION 01 73 00 - EXECUTION**

### **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. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. Installation of the Work.
  - 4. Cutting and patching.
  - 5. Coordination of Owner-installed products.
  - 6. Progress cleaning.
  - 7. Starting and adjusting.
  - 8. Protection of installed construction.
- B. Related Sections include the following:
  - 1. Section 01 31 00 "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
  - 2. Section 01 33 00 "Submittal Procedures" for submitting surveys.
  - 3. Section 01 77 00 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
  - 4. Section 07 84 13 "Penetration Firestopping" for patching penetrations in fire-rated construction.

#### **1.3 DEFINITIONS**

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

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For land surveyor.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- C. Certified Surveys: Submit two copies signed by land surveyor.
- D. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

#### **1.5 QUALITY ASSURANCE**

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
  - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
  2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work.
  2. List of detrimental conditions, including substrates.
  3. List of unacceptable installation tolerances.
  4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for interpretation to Architect according to Section 01 26 13 "Request for Interpretation."

### **3.3 CONSTRUCTION LAYOUT**

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
  - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
  - 2. Establish limits on use of Project site.
  - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  - 4. Inform installers of lines and levels to which they must comply.
  - 5. Check the location, level and plumb, of every major element as the Work progresses.
  - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
  - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect .

### **3.4 FIELD ENGINEERING**

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

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

### 3.5 INSTALLATION

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

- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produces harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.
  - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.
- K. Protect adjacent property and adjoining work, including sealant bond surfaces, from spillage or blow-over of coatings, paints, sprayed fire-resistive material, and other spray-applied products. Cover adjoining and nearby surfaces, including live plants and grass, if there is possibility of spray-applied products being deposited on surfaces.

### **3.6 OWNER-INSTALLED PRODUCTS**

- A. Site Access: Provide access to Project site for Owner's construction forces.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.



1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction forces at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

### 3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
  1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
  3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
  4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  1. Remove liquid spills promptly.
  2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted. Comply with Section 01 74 19 "Construction Waste Management and Disposal."

- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### **3.8 STARTING AND ADJUSTING**

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Section 01 40 00 "Quality Requirements."

### **3.9 PROTECTION OF INSTALLED CONSTRUCTION**

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

**END OF SECTION 01 73 00**

## SECTION 017417 - CLEANING AND SITE APPEARANCE

### PART 1 – GENERAL

#### 1.01 DESCRIPTION

A. Principal work in this Section:

1. Keep premises, adjacent private properties and public properties free from accumulations of waste, debris and rubbish caused by construction operations daily.
2. Maintain construction area in a neat and workmanlike manner. Keep all tools, equipment, and materials stored in an organized and secure fashion. Avoid layouts or methods that create a public eyesore.
3. At completion of work, remove waste materials, rubbish, tools, equipment, machinery and surplus materials, and clean all exposed surfaces.

#### 1.02 SAFETY REQUIREMENTS

A. Standards: Maintain project in accord with State and local safety standards.

B. Hazard Control

1. Store volatile wastes in covered metal containers, and remove from premises daily.
2. Prevent accumulation of wastes which create hazardous conditions.
3. Provide adequate ventilation during use of volatile or noxious substances.
4. Prevent accumulation of waste that may attract rodents, insects, or other pests.

C. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.

1. Do not turn or bury rubbish and waste materials on project site.
2. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains, or the Owner's waste containers. Store in containers with tight-fitting lids and remove to legal dump site.
3. Comply with the Los Angeles County, State of California, or City of Long Beach, which ever applies, Stormwater Pollution Control Requirements for Construction Sites which require implementation of the NPDES standards and SCAQMD requirements. The cost of implanting these standards and adhering to the Stormwater Pollution Control Requirements must be included in the lump sump bid for the Project.

### PART 2 – PRODUCTS

#### 2.01 MATERIALS:

- A. Use cleaning materials which will not create hazardous to health or property and which will not damage materials. Use cleaning materials and methods recommended by the manufacturer of the surface material to be cleaned. Use cleaning materials only on surfaces recommended by the cleaning materials manufacturer.

## PART 3 – EXECUTION

### 3.01 CLEAN-UP DURING CONSTRUCTION

- A. Keep premises, adjacent properties and public properties free from accumulations of waste materials and rubbish. Remove debris and dirt from public property promptly: sweep sidewalks and adjacent streets daily when soiled by work performed under this Contract. Maintain the existing landscaped areas within the fenced area of the construction site, including but not limited to weekly mowing and irrigation as required.
- B. Remove or paint over, as appropriate to the substrate, graffiti on the site or surrounding fence daily.
- C. Wet down materials and rubbish to settle dust and prevent it from blowing.
- D. At least once a week, or more often if required, dispose of waste materials, debris and rubbish off the site in a legal manner. Remove combustible materials such as paper and cardboard daily. Bury no such waste material and debris on the site. Burning of trash and debris on the site will not be permitted. All containers must be emptied as soon as they reach 75% of capacity.
- E. Provide on-site containers for collection of waste materials, debris and rubbish. Provide a collection can at each location used as an eating area. Pick-up all garbage daily.
- F. At the conclusion of each work day, Contractor will walk the site and collect all debris and rubbish and store all loose materials.
- G. Remove waste materials, debris and rubbish from site and legally dispose of at legal public or private dumping areas off Owner's property. Location of dump for trash and debris and length of haul is to the Contractor's responsibility.
- H. Handle materials in a controlled manner with as few handlings as possible, do not drop or throw materials from heights.
- I. Owner's right to provide clean up at the Contractor's Expense.
  - 1. Should the Construction Manager, or IOR determine that the Contractor is failing to maintain the site in a properly clean and safe manner, they will notify the Contractor that corrective action must be taken. Should the Contractors fail to clean the site after sufficient notification, the Owner reserves the right to have the site cleaned at the Contractor's expense.
  - 2. In the case of public or safety hazard, the Owner reserves the right to have the hazard corrected immediately at the Contractor's expense.

J. Contaminated Earth:

1. Clean-up operations include the removal and disposal of earth contaminated or unsuitable for support of plant life in planting areas, and filling of resulting excavations with suitable soil.
2. Contaminated areas include those used for disposal of waste concrete, mortar, plaster, masonry, and similar materials, areas in which washing out of concrete and plaster mixers or washing of tools and like cleaning operations have been performed, and areas that have been oiled, paved, or chemically treated.
3. Do not dispose of waste oil, solvents, paint, solutions, mortar, concrete of any construction material or like penetrating material by depositing or burying on the Owner's property.

3.02 FINAL SITE CLEAN-UP:

- A. In preparation of Substantial Completion or Occupancy conduct a thorough cleaning of all work.
- B. Before final inspection and after all construction activity is essentially complete, thoroughly clean the buildings, utilizing professional building cleaners. Items to be cleaned include, but are not limited to: all glass, plastic, doors, opening frames, grilles, trim, exposed nonferrous metal surfaces, floor covering, light fixtures and plates, plumbing fixtures and trim, and all finish surfaces throughout the construction. Thoroughly remove ink trademarks from all surfaces, Vacuum clean the buildings (s) and remove all spots, smears, dust, debris, hand prints and defacements of every sort, including those of vandals. Follow the recommendations of the manufacturer of the materials and items to be cleaned for all cleaning, polishing, and treatment such as waxing.
- C. Repair, patch and touch-up marred surfaces to specified finish to match adjacent surfaces.
- D. Also, before final inspection, thoroughly clean the entire site and put it into a neat, acceptable condition. Remove from the entire site all construction waste and unused materials, rubbish, loose rock and stones, excess earth, roots, weeds, and all debris of any description resulting from the Work. Hose down and scrub where necessary all new concrete and asphalt pavement and walks dirtied as a result of the Work. Thoroughly remove mortar droppings from concrete walks and other pavements.
- E. Keep project clean until Final Acceptance by the Owner.
  1. Should the Construction Manager or IOR determine that the Contractor is failing to maintain the site in a properly clean and safe manner, they will notify the Contractor that corrective action must be taken. Should the Contractor fail to clean the site after sufficient notification, the Owner reserves the right to have the site cleaned at the Contractor's expense.
  2. In the case of public or safety hazard, the Owner reserves the right to have the hazard corrected immediately, at the Contractor's expense.

END OF SECTION 017417

## SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Recycling nonhazardous demolition and construction waste.
  - 2. Disposing of nonhazardous demolition and construction waste.

#### 1.2 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

#### 1.3 ACTION SUBMITTALS

- A. **Waste Management Plan**: Submit plan within 30 days of date established for the Notice to Proceed.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste. Include the following information:
  - 1. Material category.
  - 2. Generation point of waste.
  - 3. Total quantity of waste in tons.
  - 4. Quantity of waste salvaged, both estimated and actual in tons.
  - 5. Quantity of waste recycled, both estimated and actual in tons.
  - 6. Total quantity of waste recovered (salvaged plus recycled) in tons.

7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

## 1.5 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements, that employs a LEED-Accredited Professional, certified by the USGBC, as waste management coordinator.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
  1. Review and discuss waste management plan including responsibilities of waste management coordinator.
  2. Review requirements for documenting quantities of each type of waste and its disposition.
  3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
  4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
  5. Review waste management requirements for each trade.



## 1.6 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing, and construction waste generated by the Work. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
  2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
  3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
  4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
  5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
  6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.
- D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Use Form CWM-5 for construction waste and Form CWM-6 for demolition waste. Include the following:
1. Total quantity of waste.
  2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
  3. Total cost of disposal (with no waste management).
  4. Revenue from salvaged materials.
  5. Revenue from recycled materials.
  6. Savings in hauling and tipping fees by donating materials.
  7. Savings in hauling and tipping fees that are avoided.

8. Handling and transportation costs. Include cost of collection containers for each type of waste.
9. Net additional cost or net savings from waste management plan.

## **PART 2 - PRODUCTS - Not Used**

## **PART 3 - EXECUTION**

### **3.1 PLAN IMPLEMENTATION**

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
  1. Comply with operation, termination, and removal requirements in Section 01 50 00 "Temporary Facilities and Controls."
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
  1. Distribute waste management plan to everyone concerned within three days of submittal return.
  2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
  2. Comply with Section 01 50 00 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

### **3.2 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL**

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared equally by Owner and Contractor.

- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
  - 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
    - a. Inspect containers and bins for contamination and remove contaminated materials if found.
  - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
  - 4. Store components off the ground and protect from the weather.
  - 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

### **3.3 RECYCLING DEMOLITION WASTE**

- A. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
- B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
- C. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- D. Metals: Separate metals by type.
  - 1. Structural Steel: Stack members according to size, type of member, and length.
  - 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- E. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- F. Conduit: Reduce conduit to straight lengths and store by type and size.

### **3.4 RECYCLING CONSTRUCTION WASTE**

- A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
  2. Polystyrene Packaging: Separate and bag materials.
  3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
  4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
  2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
    - a. Comply with requirements in Section 32 93 00 "Plants" for use of clean sawdust as organic mulch.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
    - a. Comply with requirements in Section 32 93 00 "Plants" for use of clean ground gypsum board as inorganic soil amendment.

### 3.5 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
  2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Burning: Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.
- D. Disposal: Remove waste materials and dispose of at designated spoil areas on Owner's property.
- E. Disposal: Remove waste materials from Owner's property and legally dispose of them.

**3.6 ATTACHMENTS**

- A. Form CWM-1 for construction waste identification.
- B. Form CWM-2 for demolition waste identification.
- C. Form CWM-3 for construction waste reduction work plan.
- D. Form CWM-4 for demolition waste reduction work plan.
- E. Form CWM-5 cost/revenue analysis of construction waste reduction work plan.
- F. Form CWM-6 cost/revenue analysis of demolition waste reduction work plan.
- G. Form CWM-7 for construction waste
- H. Form CWM-8 for demolition waste.

**END OF SECTION 01 74 19**



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<b>FORM CWM-1: CONSTRUCTION WASTE IDENTIFICATION</b>							
<b>MATERIAL CATEGORY</b>	<b>GENERATION POINT</b>	<b>EST. QUANTITY OF MATERIALS RECEIVED* (A)</b>	<b>EST. WASTE - % (B)</b>	<b>TOTAL EST. QUANTITY OF WASTE* (C = A x B)</b>	<b>EST. VOLUME CY (CM)</b>	<b>EST. WEIGHT TONS (TONNES)</b>	<b>REMARKS AND ASSUMPTIONS</b>
Packaging: Cardboard							
Packaging: Boxes							
Packaging: Plastic Sheet or Film							
Packaging: Polystyrene							
Packaging: Pallets or Skids							
Packaging: Crates							
Packaging: Paint Cans							
Packaging: Plastic Pails							
Site-Clearing Waste							
Masonry or CMU							
Lumber: Cut-Offs							
Lumber: Warped Pieces							
Plywood or OSB (scraps)							
Wood Forms							
Wood Waste Chutes							
Wood Trim (cut-offs)							
Metals							
Insulation							
Roofing							
Joint Sealant Tubes							
Gypsum Board (scraps)							
Carpet and Pad (scraps)							
Piping							
Electrical Conduit							
Other:							

\* Insert units of measure.





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<b>FORM CWM-2: DEMOLITION WASTE IDENTIFICATION</b>				
<b>MATERIAL DESCRIPTION</b>	<b>EST. QUANTITY</b>	<b>EST. VOLUME CY (CM)</b>	<b>EST. WEIGHT TONS (TONNES)</b>	<b>REMARKS AND ASSUMPTIONS</b>
Asphaltic Concrete Paving				
Concrete				
Brick				
CMU				
Lumber				
Plywood and OSB				
Wood Paneling				
Wood Trim				
Miscellaneous Metals				
Structural Steel				
Rough Hardware				
Insulation				
Roofing				
Doors and Frames				
Door Hardware				
Windows				
Glazing				
Acoustical Tile				
Carpet				
Carpet Pad				
Demountable Partitions				
Equipment				
Cabinets				
Plumbing Fixtures				
Piping				
Piping Supports and Hangers				
Valves				
Sprinklers				
Mechanical Equipment				
Electrical Conduit				
Copper Wiring				
Light Fixtures				
Lamps				
Lighting Ballasts				
Electrical Devices				
Switchgear and Panelboards				
Transformers				
Other:				



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<b>FORM CWM-3: CONSTRUCTION WASTE REDUCTION WORK PLAN</b>						
MATERIAL CATEGORY	GENERATION POINT	TOTAL EST. QUANTITY OF WASTE TONS (TONNES)	DISPOSAL METHOD AND QUANTITY			HANDLING AND TRANSPORTION PROCEDURES
			EST. AMOUNT SALVAGED TONS (TONNES)	EST. AMOUNT RECYCLED TONS (TONNES)	EST. AMOUNT DISPOSED TO LANDFILL TONS (TONNES)	
Packaging: Cardboard						
Packaging: Boxes						
Packaging: Plastic Sheet or Film						
Packaging: Polystyrene						
Packaging: Pallets or Skids						
Packaging: Crates						
Packaging: Paint Cans						
Packaging: Plastic Pails						
Site-Clearing Waste						
Masonry or CMU						
Lumber: Cut-Offs						
Lumber: Warped Pieces						
Plywood or OSB (scraps)						
Wood Forms						
Wood Waste Chutes						
Wood Trim (cut-offs)						
Metals						
Insulation						
Roofing						
Joint Sealant Tubes						
Gypsum Board (scraps)						
Carpet and Pad (scraps)						
Piping						
Electrical Conduit						
Other:						



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<b>FORM CWM-4: DEMOLITION WASTE REDUCTION WORK PLAN</b>						
MATERIAL CATEGORY	GENERATION POINT	TOTAL EST. QUANTITY OF WASTE TONS (TONNES)	DISPOSAL METHOD AND QUANTITY			HANDLING AND TRANSPORTION PROCEDURES
			EST. AMOUNT SALVAGED TONS (TONNES)	EST. AMOUNT RECYCLED TONS (TONNES)	EST. AMOUNT DISPOSED TO LANDFILL TONS (TONNES)	
Asphaltic Concrete Paving						
Concrete						
Brick						
CMU						
Lumber						
Plywood and OSB						
Wood Paneling						
Wood Trim						
Miscellaneous Metals						
Structural Steel						
Rough Hardware						
Insulation						
Roofing						
Doors and Frames						
Door Hardware						
Windows						
Glazing						
Acoustical Tile						
Carpet						
Carpet Pad						
Demountable Partitions						
Equipment						
Cabinets						
Plumbing Fixtures						
Piping						
Supports and Hangers						
Valves						
Sprinklers						
Mechanical Equipment						
Electrical Conduit						
Copper Wiring						
Light Fixtures						
Lamps						
Lighting Ballasts						
Electrical Devices						
Switchgear and Panelboards						
Transformers						
Other:						



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<b>FORM CWM-5: COST/REVENUE ANALYSIS OF CONSTRUCTION WASTE REDUCTION WORK PLAN</b>								
<b>MATERIALS</b>	<b>TOTAL QUANTITY OF MATERIALS (VOL. OR WEIGHT) (A)</b>	<b>EST. COST OF DISPOSAL (B)</b>	<b>TOTAL EST. COST OF DISPOSAL (C = A x B)</b>	<b>REVENUE FROM SALVAGED MATERIALS (D)</b>	<b>REVENUE FROM RECYCLED MATERIALS (E)</b>	<b>LANDFILL TIPPING FEES AVOIDED (F)</b>	<b>HANDLING AND TRANSPORTATION COSTS AVOIDED (G)</b>	<b>NET COST SAVINGS OF WORK PLAN (H = D+E+F+G)</b>
Packaging: Cardboard								
Packaging: Boxes								
Packaging: Plastic Sheet or Film								
Packaging: Polystyrene								
Packaging: Pallets or Skids								
Packaging: Crates								
Packaging: Paint Cans								
Packaging: Plastic Pails								
Site-Clearing Waste								
Masonry or CMU								
Lumber: Cut-Offs								
Lumber: Warped Pieces								
Plywood or OSB (scraps)								
Wood Forms								
Wood Waste Chutes								
Wood Trim (cut-offs)								
Metals								
Insulation								
Roofing								
Joint Sealant Tubes								
Gypsum Board (scraps)								
Carpet and Pad (scraps)								
Piping								
Electrical Conduit								
Other:								





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<b>FORM CWM-6: COST/REVENUE ANALYSIS OF DEMOLITION WASTE REDUCTION WORK PLAN</b>								
<b>MATERIALS</b>	<b>TOTAL QUANTITY OF MATERIALS (VOL. OR WEIGHT) (A)</b>	<b>EST. COST OF DISPOSAL (B)</b>	<b>TOTAL EST. COST OF DISPOSAL (C = A x B)</b>	<b>REVENUE FROM SALVAGED MATERIALS (D)</b>	<b>REVENUE FROM RECYCLED MATERIALS (E)</b>	<b>LANDFILL TIPPING FEES AVOIDED (F)</b>	<b>HANDLING AND TRANSPORTATION COSTS AVOIDED (G)</b>	<b>NET COST SAVINGS OF WORK PLAN (H = D+E+F+G)</b>
Asphaltic Concrete Paving								
Concrete								
Brick								
CMU								
Lumber								
Plywood and OSB								
Wood Paneling								
Wood Trim								
Miscellaneous Metals								
Structural Steel								
Rough Hardware								
Insulation								
Roofing								
Doors and Frames								
Door Hardware								
Windows								
Glazing								
Acoustical Tile								
Carpet								
Carpet Pad								
Demountable Partitions								
Equipment								
Cabinets								
Plumbing Fixtures								
Piping								
Supports and Hangers								
Valves								
Sprinklers								
Mech. Equipment								
Electrical Conduit								
Copper Wiring								
Light Fixtures								
Lamps								
Lighting Ballasts								
Electrical Devices								
Switchgear and Panelboards								
Transformers								

Other:

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**FORM CWM-7: CONSTRUCTION WASTE REDUCTION PROGRESS REPORT**

MATERIAL CATEGORY	GENERATION POINT	TOTAL QUANTITY OF WASTE (TONNES)		QUANTITY OF WASTE SALVAGED			QUANTITY OF WASTE RECYCLED		TOTAL QUANTITY OF WASTE RECOVERED TONS (TONNES) (D = B + C)	TOTAL QUANTITY OF WASTE RECOVERED % (D / A x 100)
		(A)	(B)	ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES)	ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (C)			
Packaging: Cardboard										
Packaging: Boxes										
Packaging: Plastic Sheet or Film										
Packaging: Polystyrene										
Packaging: Pallets or Skids										
Packaging: Crates										
Packaging: Paint Cans										
Packaging: Plastic Pails										
Site-Clearing Waste										
Masonry or CMU										
Lumber: Cut-Offs										
Lumber: Warped Pieces										
Plywood or OSB (scraps)										
Wood Forms										
Wood Waste Chutes										
Wood Trim (cut-offs)										
Metals										
Insulation										
Roofing										
Joint Sealant Tubes										
Gypsum Board (scraps)										
Carpet and Pad (scraps)										
Piping										
Electrical Conduit										
Other:										



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FORM CWM-8: DEMOLITION WASTE REDUCTION PROGRESS REPORT									
MATERIAL CATEGORY	GENERATION POINT	TOTAL QUANTITY OF WASTE TONS (A)	QUANTITY OF WASTE SALVAGED		ACTUAL TONS (B)	QUANTITY OF WASTE RECYCLED		TOTAL QUANTITY OF WASTE RECOVERED TONS (D = B + C)	TOTAL QUANTITY OF WASTE RECOVERED % (D / A x 100)
			ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES)		ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES)		
Asphaltic Concrete Paving									
Concrete									
Brick									
CMU									
Lumber									
Plywood and OSB									
Wood Paneling									
Wood Trim									
Miscellaneous Metals									
Structural Steel									
Rough Hardware									
Insulation									
Roofing									
Doors and Frames									
Door Hardware									
Windows									
Glazing									
Acoustical Tile									
Carpet									
Carpet Pad									
Demountable Partitions									
Equipment									
Cabinets									
Plumbing Fixtures									
Piping									
Supports and Hangers									
Valves									
Sprinklers									
Mechanical Equipment									
Electrical Conduit									
Copper Wiring									
Light Fixtures									
Lamps									
Lighting Ballasts									
Electrical Devices									
Switchgear and Panelboards									
Transformers									

Other:								
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## **SECTION 01 77 00 - CLOSEOUT PROCEDURES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for contract closeout.

#### **1.2 ACTION SUBMITTALS**

- A. Contractor's List of Incomplete Items (Punch List): Initial submittal at Substantial Completion.
- B. Certified List of Incomplete Items: Final submittal at Final Completion.

#### **1.3 CLOSEOUT SUBMITTALS**

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Project Record Documents:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record product data.
  - 4. Miscellaneous record submittals.
- D. Operation and maintenance manual(s).
- E. Warranties.

#### **1.4 MAINTENANCE MATERIAL SUBMITTALS**

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

#### **1.5 SUBSTANTIAL COMPLETION PROCEDURES**

- A. Submittals Prior to Substantial Completion: Complete the following a minimum of 5 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
  - 1. Prepare and submit a list of incomplete items (punch list), indicating the value of items on the list, and reasons why the Work is not complete.

2. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, final certifications, and similar documents.
  3. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  4. Prepare and submit Project Record Documents, operation and maintenance manuals, and similar final record information.
  5. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
    - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
  6. Submit test/adjust/balance records.
  7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- B. Procedures Prior to Substantial Completion: Complete the following prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request
1. Advise Owner of pending insurance changeover requirements.
  2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions
  3. Complete startup and testing of systems and equipment.
  4. Perform preventive maintenance on equipment used prior to Substantial Completion.
  5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment and systems. Submit demonstration and training video recordings specified in Section 01 79 00 "Demonstration and Training."
  6. Advise Owner of changeover in utility services.
  7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
  8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  9. Complete final cleaning requirements.
  10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
  11. Obtain written review of closeout documents pertinent to LEED commissioning by the Commissioning Authority. The Commissioning Plan enumerates documents required at the time of Substantial Completion.
- C. Inspection: Submit a written request for inspection for Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.



1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

## **1.6 FINAL COMPLETION PROCEDURES**

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
  1. Submit a final Application for Payment.
  2. Submit copy of Contractor's original Substantial Completion inspection list with Architect's annotations of items to be completed or corrected (punch list), endorsed and dated by Architect. Copy shall be certified by Contractor and state that each item has been completed or otherwise resolved for acceptance.
- B. Inspection: Submit a written request for final inspection for acceptance a minimum of 5 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
  1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

## **1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)**

- A. Preparation: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
  1. Organize list of spaces in sequential order, proceeding from lowest floor to highest floor.
  2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
  3. Include the following information at the top of each page:
    - a. Project name.
    - b. Date.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Page number.
- B. Submit list of incomplete items in MS Excel electronic file and three paper copies. Architect will return annotated electronic file.

## 1.8 PROJECT RECORD DOCUMENTS

- A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.
- B. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.
  - 1. Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up record prints.
    - a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later, and the locations of those items that need to be located for servicing.
    - b. Accurately record information in a readily understandable drawing technique.
    - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
    - d. Mark record prints completely and accurately.
    - e. Mark important additional information that was either shown schematically or omitted from original Drawings.
    - f. Note Change Order numbers, alternate numbers, and similar identification where applicable.
- C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Clearly mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  - 3. Note related Change Orders, Record Drawings, and Product Data, where applicable.
- D. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  - 3. Note related Change Orders, Record Drawings, where applicable.

- E. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections such as tests and inspections, and inspections by authorities having jurisdiction. Bind or file miscellaneous records and identify each, ready for continued use and reference.

## 1.9 OPERATION AND MAINTENANCE MANUALS

- A. Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:
1. Operation Data:
    - a. Emergency instructions and procedures.
    - b. System, subsystem, and equipment descriptions, including operating standards.
    - c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
    - d. Description of controls and sequence of operations.
    - e. Piping diagrams.
    - f. Noise and vibration adjustments.
    - g. Effective energy utilization.
  2. Maintenance Data:
    - a. Manufacturer's information, including list of spare parts.
    - b. Name, address, and telephone number of Installer or supplier.
    - c. Maintenance procedures.
    - d. Maintenance and service schedules for preventive and routine maintenance.
    - e. Maintenance record forms.
    - f. Sources of spare parts and maintenance materials.
    - g. Copies of maintenance service agreements.
    - h. Copies of warranties and bonds.
    - i. Cleaning.
    - j. Control sequence.
    - k. Fuels, lubricants, tool, and other related items.
    - l. Identification systems.
- B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

## **1.10 SUBMITTAL OF PROJECT WARRANTIES**

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

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

## **PART 3 - EXECUTION**

### **3.1 FINAL CLEANING**

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.

- b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
  - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
  - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
  - e. Remove snow and ice to provide safe access to building.
  - f. Clean exposed hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition.
  - g. Remove debris and surface dust from limited access spaces, including plenums, shafts, and similar spaces.
  - h. Sweep concrete floors broom clean in unoccupied spaces.
  - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
  - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
  - k. Remove labels that are not meant to be permanent.
  - l. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - o. Clean ducts, blowers, and coils if units were operated without filters during construction.
  - p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in lighting fixtures to comply with requirements for new fixtures.
  - q. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 01 50 00 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Section 01 74 19 "Construction Waste Management and Disposal."

### 3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
  2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
    - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
    - b. Do not paint over labels for fire resistive joints.
  3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
  4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

**END OF SECTION 01 77 00**

## **SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA**

### **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 and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory manuals.
  - 2. Emergency manuals.
  - 3. Systems and equipment operation manuals.
  - 4. Systems and equipment maintenance manuals.
  - 5. Product maintenance manuals.
- B. Related Requirements:
  - 1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

#### **1.3 DEFINITIONS**

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

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
  - 1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
  - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

- B. Format: Submit operation and maintenance manuals in the following format:
  - 1. Initial Manual Submittal: Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.
  - 2. Final Manual Submittal: Submit three paper copies, and one copy on digital media. Architect will return two copies.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
  - 1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.
- E. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

## 1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
  - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
  - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.



- a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
  - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
  3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
  4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
  5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

## **1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS**

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  1. Title page.
  2. Table of contents.
  3. Manual contents.
- B. Title Page: Include the following information:
  1. Subject matter included in manual.
  2. Name and address of Project.
  3. Name and address of Owner.
  4. Date of submittal.
  5. Name and contact information for Contractor.
  6. Name and contact information for Construction Manager.
  7. Name and contact information for Architect.
  8. Name and contact information for Commissioning Authority.

9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
  10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

#### **1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL**

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

#### **1.8 EMERGENCY MANUALS**

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
  2. Emergency instructions.
  3. Emergency procedures.

- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
  2. Flood.
  3. Gas leak.
  4. Water leak.
  5. Power failure.
  6. Water outage.
  7. System, subsystem, or equipment failure.
  8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
  2. Shutdown instructions for each type of emergency.
  3. Operating instructions for conditions outside normal operating limits.
  4. Required sequences for electric or electronic systems.
  5. Special operating instructions and procedures.

## 1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
  2. Performance and design criteria if Contractor has delegated design responsibility.
  3. Operating standards.
  4. Operating procedures.
  5. Operating logs.
  6. Wiring diagrams.
  7. Control diagrams.
  8. Piped system diagrams.

9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

### **1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS**

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
    - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
  2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  3. Identification and nomenclature of parts and components.
  4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
  2. Troubleshooting guide.
  3. Precautions against improper maintenance.
  4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  5. Aligning, adjusting, and checking instructions.
  6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
  - 1. Do not use original project record documents as part of maintenance manuals.

#### **1.11 PRODUCT MAINTENANCE MANUALS**

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

- 5. Repair instructions.
  
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
  
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 78 23**





## SECTION 017836 - WARRANTIES

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

- A. This Section includes administrative and procedural requirements for warranties required by the Contract Documents, including manufacturers and/or installer's standard warranties on products and special product warranties.
  - 1. Refer to the General Conditions for terms of the guarantee period for the Work.

#### 1.02 RELATED SECTIONS

- A. Section 016010: Materials and Equipment
- B. Section 017700: Closeout Procedures

### PART 2 - PRODUCTS (Not applicable)

### PART 3 - EXECUTION

#### 3.01 WARRANTY REQUIREMENTS

- A. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties shall not relieve CONTRACTOR of the warranty of the Work incorporating such materials, products, and/or equipment. Manufacturer's disclaimers and limitations on warranties do not relieve suppliers, manufacturers, installers, and Subcontractors of the requirement to countersign special warranties with CONTRACTOR.
- B. Standard warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to OWNER.
- C. Special warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for OWNER.
- D. Related Damages and Losses: When correcting failed or defective warranted Work, remove and replace Work that has been damaged as a result of such failure or which must be removed and replaced to provide access for correction of warranted Work.

- E. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement with the reinstated warranty equal to the original warranty.
- F. Replacement Cost: Upon determination the Work covered by a warranty has failed and/or is defective, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. CONTRACTOR is responsible for the cost of replacing or rebuilding defective Work regardless of whether OWNER has benefited from use of the Work through a portion of its anticipated useful service life.
- G. OWNER Recourse: Expressed warranties made to OWNER are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which OWNER can enforce such other duties, obligations, rights, or remedies.
- H. Rejection of Warranties: BMT reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
- I. Where the Contract Documents require a special warranty, or similar commitment on the Work or part of the Work, BMT reserves the right to refuse to accept the Work until CONTRACTOR presents evidence the entities required to countersign such commitments have done so.

### 3.02 SUBMITTALS

- A. Submit written preliminary warranties prior to Substantial Completion, and final warranties prior to Contract Completion. If the certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, submit written warranties as set forth in the certificate of Substantial Completion.
  - 1. When a designated portion of the Work is partially used and/or occupied by OWNER, submit properly executed warranties to ARCHITECT within fifteen (15) days of the Partial Use or Occupancy of the designated portion of the Work.
- B. When the Contract Documents require CONTRACTOR, or CONTRACTOR and a Subcontractor, installer, supplier or manufacturer to execute a special warranty, prepare a written document containing appropriate terms and identification, ready for execution by the required parties. Submit a draft to BMT, through the ARCHITECT, for approval prior to final execution.
  - 1. Refer to Divisions 02 through 32 for specific content requirements and particular requirements for submitting special warranties.
- C. Form of Submittal: Prior to Contract Completion, compile two copies of each required final warranty properly executed by CONTRACTOR, or by CONTRACTOR and Subcontractor, installer, supplier, or manufacturer.

Organize the warranty documents into an orderly sequence based on the Specifications.

- D. Once draft warranties are approved, provide an electronic copy, through Procore, of all warranties as well as one original "hard Copy" in a heavy-duty, commercial-quality, durable 3-ring, vinyl-covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8½ by 11" (115 by 280 mm) paper.
1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the item or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address, and telephone number of the installer.
  2. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project title and/or name, and name of CONTRACTOR.
  3. When warranted Work requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.
- E. Contractor to provide a directory in electronic excel format and hard copy with information sorted by specification to list the following information, at a minimum: Specification Section, Description of Specification Section, Actual System or Work Installed, Subcontractor, Subcontractor Contact Person, Subcontractor Contact Person Phone Number, Subcontractor Contact Person e-mail address

END OF SECTION 017836

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## SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

### 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 and procedural requirements for project record documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.
  - 4. Miscellaneous record submittals.
- B. Related Requirements:
  - 1. Section 01 73 00 "Execution" for final property survey.
  - 2. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
  - 3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit copies of record Drawings as follows:
    - a. Initial Submittal:
      - 1) Submit PDF electronic files of scanned record prints and one of file prints.
      - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
    - b. Final Submittal:
      - 1) Submit PDF electronic files of scanned record prints and three set(s) of prints.
      - 2) Print each drawing, whether or not changes and additional information were recorded.

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

#### 1.4 RECORD DRAWINGS

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

- n. Record information on the Work that is shown only schematically.
  3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Format: Annotated PDF electronic file with comment function enabled.
  3. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Architect.
    - e. Name of Contractor.

## 1.5 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
  4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
  5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file .

## 1.6 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

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

#### **1.7 MISCELLANEOUS RECORD SUBMITTALS**

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

#### **1.8 MAINTENANCE OF RECORD DOCUMENTS**

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

#### **PART 2 - PRODUCTS (Not Used)**

#### **PART 3 - EXECUTION (Not Used)**

#### **END OF SECTION 01 78 39**



## **SECTION 01 79 00 - DEMONSTRATION AND TRAINING**

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

#### **1.3 INFORMATIONAL SUBMITTALS**

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

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
  - 1. Identification: On each copy, provide an applied label with the following information:
    - a. Name of Project.

- b. Name and address of videographer.
  - c. Name of Architect.
  - d. Name of Construction Manager.
  - e. Name of Contractor.
  - f. Date of video recording.
2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
  3. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 01 78 23 "Operation and Maintenance Data."

## 1.5 QUALITY ASSURANCE

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

## 1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

## 1.7 INSTRUCTION PROGRAM

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

- a. Startup procedures.
  - b. Equipment or system break-in procedures.
  - c. Routine and normal operating instructions.
  - d. Regulation and control procedures.
  - e. Control sequences.
  - f. Safety procedures.
  - g. Instructions on stopping.
  - h. Normal shutdown instructions.
  - i. Operating procedures for emergencies.
  - j. Operating procedures for system, subsystem, or equipment failure.
  - k. Seasonal and weekend operating instructions.
  - l. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
  - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning.
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

## **1.8 PREPARATION**

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

## **1.9 INSTRUCTION**

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

## **1.10 DEMONSTRATION AND TRAINING VIDEO RECORDINGS**

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

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

**Gensler**  
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January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 79 00**





## SECTION 01 81 19 - INDOOR AIR QUALITY (IAQ) MANAGEMENT

### 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. Special requirements for Indoor Air Quality (IAQ) management during construction operations.
    - a. Control of emissions during construction.
    - b. Moisture control during construction.
  - 2. Procedures for testing baseline IAQ. Baseline IAQ requirements specify maximum indoor pollutant concentrations for acceptance of the facility.

#### 1.3 REFERENCES

- A. Definitions: Definitions pertaining to sustainable development: As defined in ASTM E 2114.
  - 1. Adequate Ventilation: Ventilation, including air circulation and air changes, required to cure materials, dissipate humidity, and prevent accumulation of particulates, dust, fumes, vapors, or gases.
  - 2. Hazardous Materials: Any material that is regulated as a hazardous material in accordance with 49 CFR 173, requires a Material Safety Data Sheet (MSDS) in accordance with 29 CFR 1910.1200, or which during end use, treatment, handling, storage, transportation or disposal meets or has components which meet or have the potential to meet the definition of a Hazardous Waste in accordance with 40 CFR 261.
    - a. Hazardous materials include: pesticides, biocides, and carcinogens as listed by recognized authorities, such as the Environmental Protection Agency (EPA) and the International Agency for Research on Cancer (IARC).
  - 3. Indoor Air Quality (IAQ): The composition and characteristics of the air in an enclosed space that affect the occupants of that space. The indoor air quality of a space refers to the relative quality of air in a building with respect to contaminants and hazards and is determined by the level of indoor air pollution and other characteristics of the air, including those that impact thermal comfort such as air temperature, relative humidity and air speed.

4. Interior Final Finishes: Materials and products that will be exposed at interior, occupied spaces; including flooring, wallcovering, finish carpentry, ceilings, and sealants.
5. Packaged Dry Products: Materials and products that are installed in dry form and are delivered to the site in manufacturer's packaging; including carpets, resilient flooring, ceiling tiles, and insulation.
6. Wet Products: Materials and products installed in wet form, including paints, sealants, adhesives, special coatings, and other materials which require curing.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preconstruction Conference: After award of Contract and prior to the commencement of the Work, schedule and conduct meeting with Owner and Architect to discuss the proposed IAQ Management Plan and to develop mutual understanding relative to details of environmental protection.

#### 1.5 SUBMITTALS

- A. **Indoor Air Quality (IAQ) Management Plan:** Not less than 10 days before the preconstruction conference, prepare and submit an IAQ Management Plan including, but not limited to, the following:
  1. Procedures for control of emissions during construction.
    - a. Identify schedule for application of interior finishes.
  2. Procedures for moisture control during construction.
    - a. Identify porous materials and absorptive materials.
    - b. Identify schedule for inspection of stored and installed absorptive materials.
  3. Revise and resubmit Plan as required by Architect.
    - a. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations.
- B. Product Data:
  1. Submit product data for filtration media used during construction and during operation. Include Minimum Efficiency Reporting Value (MERV).
  2. Submit air pressure difference maps for each mode of operation of HVAC.
  3. Material Safety Data Sheets: Submit MSDSs for inclusion in Operation and Maintenance Manual for the following products.
    - a. Adhesives.
    - b. Floor and wall patching/leveling materials.
    - c. Caulking and sealants.
    - d. Insulating materials.
    - e. Fireproofing and firestopping.

- f. Carpet.
- g. Paint.
- h. Clear finish for wood surfaces.
- i. Lubricants.
- j. Cleaning products.

C. Inspection and Test Reports:

- 1. Moisture control inspections.
- 2. Moisture content testing.
- 3. Moisture penetration testing.
- 4. Microbial growth testing.
- 5. Baseline Indoor Air Quality test report.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Minimum of 5 years experience in performing the types of testing specified herein.

## PART 2 - PRODUCTS

### 2.1 GENERAL ENVIRONMENTAL ISSUES

- A. Mold and Mildew: Materials that have evidence of growth of molds or mildew are not acceptable, including both stored and installed materials. Immediately remove from site and dispose of properly.
- B. Moisture Stains: Materials that have evidence of moisture damage, including stains, are not acceptable, including both stored and installed materials. Immediately remove from site and dispose of properly.

### 2.2 AIR FILTRATION MEDIA

- A. Minimum Efficiency Reporting Value (MERV) as determined by ASHRAE 52.2:
  - 1. MERV-8 for filtration media used at each return air grill, if used during construction.
  - 2. MERV-13, for filtration media installed at the end of construction and prior to occupancy.

### 2.3 CLEANING PRODUCTS

- A. Use low-toxic and lowest-emitting spot removers and cleaning agents for surfaces, equipment, and workers' personal use.
- B. Use HEPA-filter equipped vacuum cleaners for the final cleaning.

## **PART 3 - EXECUTION**

### **3.1 IAQ MANAGEMENT - EMISSIONS CONTROL**

- A. HVAC Protection:
  - 1. Seal return registers during construction operations.
  - 2. Provide temporary exhaust during construction operations
  - 3. To the greatest extent possible, isolate and/or shut down the return side of the HVAC system during construction. When ventilation system must be operational during construction activities, provide temporary filters.
  
- B. Source Control:
  - 1. Provide low and zero VOC materials as specified.
  - 2. Do not use products in combination with or in contact with other products that can be identified as combining to form toxic fumes or sustained odors.
  
- C. Pathway Interruption: Isolate areas of work as necessary to prevent contamination of clean or occupied spaces. Provide pressure differentials and/or physical barriers to protect clean or occupied spaces.
  
- D. Housekeeping: During construction, maintain project and building products and systems to prevent contamination of building spaces.
  
- E. Do not permit use of tobacco products inside the building, and within 25 feet (7.5 meters) of building entrance during construction.
  
- F. Temporary Ventilation: Provide an ACH (air changes per hour) of 1.5 or more and as follows:
  - 1. Provide minimum 48-hour pre-ventilation of packaged dry products prior to installation. Remove from packaging and ventilate in a secure, dry, well-ventilated space free from strong contaminant sources and residues. Provide a temperature range of 60 deg F minimum to 90 deg F maximum continuously during the ventilation period. Do not ventilate within limits of Work unless otherwise approved by Architect.
  - 2. Provide adequate ventilation during and after installation of interior wet products and interior final finishes.
  - 3. Provide filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 as determined by ASHRAE 52.2 during construction and during Owner occupancy. Coordinate with Work of Division 23, Heating, Ventilating, and Air Conditioning (HVAC).
    - a. Replace filters during construction as necessary to protect equipment and indoor air quality.

- G. Scheduling: Schedule construction operations involving wet products prior to packaged dry products to the greatest extent possible.
  - 1. Do not use solvents within interior areas that may penetrate and be retained in absorptive materials such as concrete, gypsum board, wood, cellulose products, fibrous material, and textiles.
- H. Inspect ductwork for refuse, contaminants, moisture, and other foreign contamination prior to commissioning by Owner. Notify Owner of satisfactory inspection prior to beginning of commissioning.

### 3.2 IAQ MANAGEMENT - MOISTURE CONTROL

- A. Housekeeping:
  - 1. Keep materials dry. Protect stored on-site and installed absorptive materials from moisture damage.
  - 2. Verify that installed materials and products are dry prior to sealing and weatherproofing the building envelope.
  - 3. Install interior absorptive materials only after building envelope is sealed and weatherproofed.
- B. Inspections: Document and report results of inspections; state whether or not inspections indicate satisfactory conditions.
  - 1. Examine materials for dampness as they arrive. If acceptable to Architect, dry damp materials completely prior to installation; otherwise, reject materials that arrive damp.
  - 2. Examine materials for mold as they arrive and reject materials that arrive contaminated with mold.
  - 3. Inspect stored and installed absorptive materials regularly for dampness and mold growth. Inspect after each rain event .
    - a. Where stored on-site or installed absorptive materials become wet, notify Architect. Inspect for damage. If acceptable to Architect, dry completely prior to closing in assemblies; otherwise, remove and replace with new materials.
  - 4. Basement: Monitor basement and crawlspace humidity, and dehumidify when relative humidity is greater than 85 percent for more than two weeks, or at the first sign of mold growth.
  - 5. Site Drainage: Verify that final grades of site work and landscaping drain surface water and ground water away from the building.
  - 6. Weatherproofing: Inspect moisture control materials as they are being installed. Include the following:
    - a. Air Barrier: Verify air barrier is installed without punctures and/or other damage. Verify air barrier is sealed completely.
    - b. Flashing: Verify correct shingling of the flashing for roof, walls, windows, doors, and other penetrations.

- c. Insulation Layer: Verify insulation is installed without voids.
  - d. Roofing: In accordance with ASTM D 7186.
7. Plumbing: Verify satisfactory pressure test of pipes and drains is performed before closing in and insulating lines.
8. HVAC: Inspect HVAC system as specified in Section 01 91 13 "General Commissioning." And, inspect HVAC to verify the following:
- a. Condensate pans are sloped and plumbed correctly.
  - b. Access panels are installed to allow for inspection and cleaning of coils and ductwork downstream of coils.
  - c. Ductwork and return plenums are air sealed.
  - d. Duct insulation is installed and sealed.
  - e. Chilled water line and refrigerant line insulation are installed and sealed.
- C. Schedule:
- 1. Schedule work such that absorptive materials, including but not limited to porous insulations, paper-faced gypsum board, ceiling tile, and finish flooring, are not installed until they can be protected from rain and construction-related water.
  - 2. Weatherproof as quickly as possible. Schedule installation of moisture-control materials, including but not limited to air barriers, flashing, exterior sealants and roofing, at the earliest possible time.
- D. Testing for Moisture Content: Test moisture content of porous materials and absorptive materials to ensure that they are dry before sealing them into an assembly. Document and report results of testing. Where tests are not satisfactory, dry materials and retest. If satisfactory results cannot be obtained with retest, remove and replace with new materials.
- 1. Concrete: Moisture test prior to finish flooring application as specified in Division 09.
  - 2. Wood: Moisture test as per ASTM D 4444 - Standard Test Methods for Use and Calibration of Hand-Held Moisture Meters; unless otherwise indicated, acceptable upper limits for wood products are less than 20 percent at center of piece; less than 15 percent at surface.
  - 3. Gypsum Board, Insulation, and Other Absorptive Materials: Moisture test with a Pinless Moisture Meter to assess patterns of moisture, if any.

### **3.3 BASELINE INDOOR AIR QUALITY TESTING**

- A. After construction ends and prior to occupancy, conduct a baseline indoor air quality testing procedure that randomly selects sampling points for every 25,000 sq. ft., or for each contiguous floor area, whichever is larger, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in the USGBC's "LEED Reference Guide for Building Design and Construction."
- B. Demonstrate that the chemical contaminant maximum concentrations listed below are not exceeded:

1. Carbon Dioxide (CO<sub>2</sub>): Maximum concentration of 530 parts per million per ASHRAE 62.
    - a. This measurement is required only if the building is regularly occupied during the testing. Measured differential between indoor and outdoor conditions is based on occupancy type as defined by ASHRAE 62. Maximum concentration differential in parts per million = 10,300/ventilation rate per occupant, in cubic feet per minute, assuming an occupancy of 7 persons per 1000 sq. ft. of floor space.
  2. Formaldehyde: 27 parts per billion.
  3. Particulates (PM10): 50 micrograms per cubic meter per EPA National Ambient Air Quality Standard.
  4. Ozone: 0.075 ppm, according to ASTM D 5149.
  5. Total Volatile Organic Compounds: 500 micrograms per cubic meter per State of Washington IAQ Standard.
  6. 4-Phenylcyclohexene (4-PH): 6.5 micrograms per cubic meter per State of Washington IAQ Standard.
- C. For each building area where the maximum concentration limits are exceeded, conduct a partial building flushout, for a maximum of two weeks, then retest the indoor air quality levels to indicate the requirements are achieved.

**END OF SECTION 01 81 19**





## **SECTION 01 81 23 - CALGREEN REQUIREMENTS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes general requirements and procedures for compliance with certain provisions of the California Green Building Standards Code, also known and hereinafter referred to as the "Code."
  - 1. Other prerequisites and credits needed to obtain Code compliance depend on material selections and may not be specifically identified as requirements for Code compliance. Compliance with requirements needed to obtain Code compliance may be used as one criterion to evaluate substitution requests and comparable product requests.
  - 2. Additional requirements needed to obtain Code compliance depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
  - 3. Sample compliance forms and worksheets are provided at the end of this Section, for information only. Provide required data in form acceptable to Architect and authorities having jurisdiction.
  
- B. Related Sections:
  - 1. Divisions 01 through 33 Sections for requirements for Code compliance specific to the work of each of these Sections.
  - 2. Section 01 50 00 "Temporary Facilities and Controls" for storm water pollution prevention plan.
  - 3. Section 01 74 19 "Construction Waste Management and Disposal" for construction waste management plan.

#### **1.2 REFERENCE**

- A. ARB: California Air Resources Board.
- B. CCR: California Code of Regulations.
- C. SCAQMD: South Coast Air Quality Management District.

#### **1.3 DEFINITIONS**

- A. Building Commissioning: A systematic quality assurance process that spans the entire design and construction process, including verifying and documenting that building systems and components are planned, designed, installed, tested, operated and maintained to meet the owner's project requirements.

- B. Composite Wood Products: Composite wood products include hardwood plywood, particleboard and medium density fiberboard. "Composite wood products" does not include hardboard, structural plywood, structural panels, structural composite lumber, oriented strand board, glued laminated timber, prefabricated wood I-joists or finger-jointed lumber, all as specified in California Code of Regulations (CCR), Title 17, Section 93120.1(a).
- C. Recycled Content: The percentage by weight of constituents that have been recovered or otherwise diverted from the solid waste stream, either during the manufacturing process (pre-consumer), or after consumer use (post-consumer).
1. Spills and scraps from the original manufacturing process that are combined with other constituents after a minimal amount of reprocessing for use in further production of the same product are not recycled materials.
  2. Discarded materials from one manufacturing process that are used as constituents in another manufacturing process are pre-consumer recycled materials.
- D. Recycled Content Value: Material cost multiplied by postconsumer content plus 1/2 the preconsumer content, or  $RCV = \$ X (\text{postconsumer content} + 1/2 \text{ preconsumer content})$ :
1. "Post-consumer waste" is defined as waste material generated by consumers after it is used and which would otherwise be discarded.
  2. "Pre-consumer waste" is defined as material diverted from the waste stream during the manufacturing process, including scraps, damaged goods, and excess production that is used in another manufacturing process.
- E. Maximum Incremental Reactivity (MIR): The maximum change in weight of ozone formed by adding a compound to the "Base Reactive Organic Gas (ROG) Mixture" per weight of compound added, expressed to hundredths of a gram.
1. MIR values for individual compounds and hydrocarbons solvents are specified in CCR, Title 17, Section 94700 and Section 94701.
- F. Reactive Organic Compound (ROC): Any compound that has the potential, once emitted, to contribute to ozone formation in the troposphere.
- G. Product-Weight MIR (PWMIR): The sum of all weighted-MIR for all ingredients in a product subject to this article. The PWMIR is the total product reactivity expressed to hundredths of a gram of ozone formed per gram of product (excluding container and packaging).
1. PWMIR is calculated according to equations found in CCR, Title 17, Section 94521(a).
- H. VOC: A volatile organic compound (VOC) is broadly defined as a chemical compound based on carbon chains or rings with vapor pressures greater than 0.1 millimeters of mercury at room temperature. These compounds typically contain hydrogen and may contain oxygen, nitrogen and other elements. See CCR Title 17, Section 94508(a).

1. Note: Where specific regulations are cited from different agencies such as South Coast Air Quality Management District (SCAQMD), California Air Resources Board (ARB), etc., the VOC definition included in that specific regulation is the one that prevails for the specific measure in question.

#### **1.4 SUBMITTALS**

- A. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:
  1. Plumbing.
  2. Mechanical.
  3. Electrical.
  4. Wood-based construction materials.
- B. Action Plans: Provide preliminary submittals within 14 days of date established for the Notice to Proceed indicating how the following requirements will be met:
  1. Storm Water Pollution Prevention Plan: Comply with Section 01 50 00 "Temporary Facilities and Controls."
  2. Construction Waste Management Plan: Comply with Section 01 74 19 "Construction Waste Management and Disposal."
  3. List of materials and procedures for covering of duct openings and protection of mechanical equipment.
- C. Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with Action Plans for the following:
  1. Waste reduction progress reports complying with Section 01 74 19 "Construction Waste Management and Disposal."
  2. Recycled content.
- D. Documentation Submittals:
  1. Receipts for salvaged and refurbished materials used for Project, indicating sources and costs for salvaged and refurbished materials.
  2. Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
  3. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the approach employed, documenting protection of ducts and HVAC equipment.
  4. Product data for adhesives, sealants and caulks, indicating VOC content of each product used. Indicate VOC content in g/L calculated according to SCAQMD Rule 1168 VOC limits and CCR Title 17 for aerosols.

5. Product data for paints and coatings, indicating VOC content of each product used. Indicate VOC content in g/L calculated according to the Air Resource Board Architectural Coatings Suggested Control Measure and CCAR Title 17 for aerosols.
6. Product data for carpet used inside the weatherproofing system indicating compliance with the Carpet and Rug Institute "Green Label Plus Program"; compliance with the VOC-emission limits and testing requirements specified in the California Department of Public Health Standard Practice Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1, February.; compliance with NSF/ANSI 140 at the Gold Level or higher; compliance with (CA-CHPS) Criteria Interpretation for EQ 7.0 and EQ 7.1 dated July 2012 and listed in the CHPS High Performance Product database, or other standard accepted by authorities having jurisdiction.
7. Product data for carpet cushion used inside the weatherproofing system indicating compliance with the Carpet and Rug Institute "Green Label Program".
8. Product data for resilient flooring indicating compliance with the VOC-emissions limits and testing requirements specified in the California Department of Public Health's 2010 Standard Method for the Testing and Evaluation Chambers, Version 1.1, February 2010; compliance with the Collaborative for CA-CHPS Criteria Interpretation for EQ 7.0 and EQ 7.1 dated July 2012 and listed in the CHPS High Performance Product Database; certification under UL GREENGUARD or certification under the Resilient Floor Covering Institute (RFCI) Floor Score program.
9. Product data, manufacturer's certifications, chain of custody certifications, or other documentation acceptable to authorities having jurisdiction; for products containing composite wood or agrifiber products or wood glues. Indicate compliance with ARB Air Toxics Control Measure for Composite Wood.
10. Product Data for residential appliances, indicating that products are ENERGY STAR rated.
11. Product data for carbon dioxide (CO<sub>2</sub>) sensors and controls.
12. Product data for HVAC, refrigeration, and fire suppression equipment and systems, indicating no use of Chlorofluorocarbons (CFCs) and Halons.
13. Product data for wood- burning appliances indicating compliance with requirements for direct venting as defined and required by the California Energy Code, Title 24, Part 6, Subchapter 7, Section 150, and for compliance with United State Environmental Protection Agency (USEPA) Phase II emission limits where applicable..
14. Product data for irrigation systems components including but not necessarily limited to the following:
  - a. Sprinkler heads: Indicate degree of head rotation and spray characteristics/ pattern.
  - b. Controllers and sensors.
15. Product data and schedules for plumbing fixtures and fittings. Include rated capacities and operating characteristics.
16. Product data, including photometrics, for interior and exterior lighting fixtures. Include Testing Agency and Manufacturer's certified data.
17. Qualifications data for HVAC system installers' certification. Include employee names, positions, dates of service, types of certification, certification program names, descriptions, dates of completion, and dates of expiration.

## **PART 2 - PRODUCTS**

### **2.1 ADHESIVES, SEALANTS AND CAULKS**

- A. For field applications, use adhesives, sealants and caulks that comply with the indicated limits for VOC content when calculated according to SCAQMD Rule 1168 VOC limits and CCR Title 17 for aerosols.
- B. Adhesive VOC Limits:
1. Architectural Applications:
    - a. Indoor carpet adhesives: 50 g/L.
    - b. Wood flooring adhesive: 100 g/L.
    - c. Rubber floor adhesives: 60 g/L.
    - d. Ceramic tile adhesives: 65 g/L.
    - e. VCT and asphalt tile adhesives: 50 g/L.
    - f. Drywall and panel adhesives: 50 g/L.
    - g. Cove base adhesives: 50 g/L.
    - h. Multipurpose construction adhesives: 70 g/L.
    - i. Single-ply roof membrane adhesives: 250 g/L.
  2. Specialty Applications:
    - a. PVC welding: 510 g/L.
    - b. CPVC welding: 490 g/L.
    - c. ABS welding: 325 g/L.
    - d. Plastic cement welding: 250 g/L.
    - e. Top and trim adhesive: 250 g/L.
  3. Substrate-Specific Applications:
    - a. Metal to metal: 30 g/L.
    - b. Plastic foams: 50 g/L.
    - c. Porous material: (except wood) 50 g/L.
    - d. Wood: 30 g/L.
- C. Sealant and Sealant Primer VOC Limits:
1. Sealants:
    - a. Architectural: 250 g/L.
    - b. Roadway: 250 g/L.
    - c. Single-ply roof membrane: 450 g/L.
  2. Sealant Primers:

- a. Architectural nonporous: 250 g/L.
- b. Architectural porous: 775 g/L.

## 2.2 PAINTS AND COATINGS

- A. For field applications, use paints and coatings that comply with the indicated limits for VOC content when calculated according to CEPA Air Resources Board Architectural Coatings Suggested Control Measure and CCR Title 17 for aerosols. Additionally, comply with more stringent local limits where they occur.
  1. Specialty Coatings:
    - a. Bond breakers: 350 g/L.
    - b. Concrete curing compounds: 100 g/L.
    - c. Form-release compounds: 100 g/L.
    - d. Industrial maintenance coatings 100 g/L.
    - e. Pretreatment wash primers: 420 g/L.
    - f. Primers, sealers and undercoaters: 100 g/L.
    - g. Reactive penetrating sealers: 350 g/L.
    - h. Traffic marking coatings: 100 g/L.
    - i. Waterproofing membranes: 100 g/L.
    - j. Zinc-rich primers: 100 g/L.
- B. Coatings that do not meet the definitions for the specialty coatings categories indicated above shall be determined by classifying the coating as a Flat, Nonflat or Nonflat-High Gloss coating, based on its gloss, as defined in Subsections 4.21, 4.36 and 4.37 of the 2007 California Air Resources Board Suggested Control Measure.
  1. Flat coatings: 50 g/L.
  2. Nonflat coatings: 50 g/L.
  3. Nonflat high gloss coatings: 50 g/L.

## 2.3 COMPOSITE WOOD

- A. Composite wood must comply with indicated limits for formaldehyde as derived from those specified by the ARB's, Air Toxics Control Measure (ATCN) for Composite Wood in accordance with ASTM E 1333-96, and as specified in CCR, Title 17, Sections 93120 through 93120.12.
  1. Formaldehyde Limits: Maximum formaldehyde emissions:
    - a. Hardwood Plywood Veneer Core: 0.05 ppm.
    - b. Hardwood Plywood Composite Core: 0.05 ppm.
    - c. Particle Board: 0.09 ppm.
    - d. Medium Density Fiberboard: 0.11 ppm.

## 2.4 CARPET

- A. Carpet must comply with one or more of the following:
1. Carpet and Rug Institute Green Label Plus Program;
  2. Compliant with the VOC-emission limits and testing requirements specified in the California Department of Public Health Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1, February;
  3. NSF/ANSI 140 at the Gold Level or higher;
  4. Scientific Certification Systems Sustainable Choice;
  5. Compliant with the Collaborative for High Performance Schools California (CA-CHPS) Criteria Interpretation for EQ 7.0 and EQ 7.1 dated July 2012 and listed in the CHPS High Performance Product database.
- B. Carpet cushion must comply with the requirements of the Carpet and Rug Institute Green Label Program.

## 2.5 RESILIENT FLOORING SYSTEMS

- A. For 80% of the floor area receiving resilient flooring, installed resilient flooring shall meet at least one of the following:
1. Compliant with the VOC-emissions limits and testing requirements specified in the California Department of Public Health's 2010 Standard Method for the Testing and Evaluation Chambers, Version 1.1, February 2010;
  2. Certified under the Resilient Floor Covering Institute (RFCI) FloorScore program;
  3. Compliant with the Collaborative for High Performance Schools California (CA-CHPS) Criteria Interpretation for EQ 7.0 and EQ 7.1 dated July 2012 and listed in the CHPS High Performance Product Database;
  4. Products certified under UL GREENGUARD.

## 2.6 LIGHT POLLUTION

- A. All new lighting shall comply with the following in accordance with 5.106.8 and 10.106.8:
1. Outdoor lighting systems, with the exception of emergency lighting, shall be designed and installed to comply with the following:
    - a. The minimum requirements in the California Energy Code for Lighting Zones 1-4 as defined in Chapter 10 of the California Administrative Code; and
    - b. Backlight, Uplight and Glare (BUG) ratings as defined in IES TM-15-11; and
    - c. Allowable BUG ratings not exceeding those shown in California Green Building Standards Code (CALgreen) Table 5.106.8.

**2.7 ENERGY STAR**

- A. In accordance with CALgreen A5.303.3, new residential grade equipment appliances provided and installed shall be ENERGY STAR labeled if ENERGY STAR is applicable to that equipment or appliance.

**2.8 PLUMBING**

- A. New plumbing fixtures and fittings shall comply with CALgreen Section 5.303.3.

**PART 3 - EXECUTION**

**3.1 CONSTRUCTION WASTE MANAGEMENT**

- A. Comply with Section 01 74 19 "Construction Waste Management and Disposal."

**3.2 BUILDING COMMISSIONING**

- A. Comply with Section 01 19 13 "General Commissioning Requirements."

**END OF SECTION 01 81 23**



## SECTION 018620 - TEST AND BALANCE

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

- A. This Section specifies the requirements for test and balance of HVAC and related systems.

#### 1.02 RELATED SECTIONS

- A. Section 011000: Summary
- B. Section 013300: Submittal Procedures
- C. Section 013210: Construction Schedule
- D. Section 017700: Closeout Procedures
- E. Division 23 - Heating Ventilating and Air Conditioning

### PART 2 - PRODUCTS (Not used)

### PART 3 - EXECUTION

#### 3.01 DEFINITIONS AND APPLICABLE PUBLICATIONS

- A. For the purposes of this Section definitions are as indicated in applicable publications of AABC, NEBB, TABB, ASHRAE, ANSI and SMACNA.
  - 1. TAB: Testing, Adjusting and Balancing.
  - 2. TABB: Testing, Adjusting and Balancing Bureau.
  - 3. AABC: Associated Air Balance Council
  - 4. NEBB: National Environmental Balancing Bureau.
  - 5. OAR: OWNER'S Authorized Representative, Bond Management Team (BMT)
  - 6. IOR: Inspector of Record

#### 3.02 QUALITY ASSURANCE

- A. The test and balance agency shall be directly subcontracted to CONTRACTOR. The qualifications of the agency shall comply with Section 3.02, Quality

Assurance. The agency shall be responsible for furnishing labor, instruments, and tools required to test, adjust and balance the heating, ventilating and air conditioning (HVAC) systems and related plumbing systems, as described and/or as indicated in the Contract Documents.

- B. CONTRACTOR shall obtain services of an independent, qualified testing agency acceptable to Architect and Districts Commissioning Agent (if one is employed) to perform testing and balancing Work as specified and as follows:
1. Agency shall be currently certified by either The Associated Air Balance Council (AABC), The National Environmental Balancing Bureau (NEBB) or Testing, Adjusting and Balancing Bureau (TABB). NEBB or TABB certification shall be for Air and Hydronic Testing, Adjusting and Balancing and Sound and Vibration Measurement.
  2. Work shall be in accordance with the latest edition of the AABC, NEBB or TABB National Standards. Where the requirements of the two standards are different, the more stringent requirements shall prevail. Also, if the Contract Documents impose a more stringent standard than the Contract Documents shall prevail.
- C. Performance Criteria: Work of this Section shall be performed in accordance with approved Testing, Adjusting and Balancing agenda.
- D. Test Equipment Criteria: Basic instrumentation requirements and accuracy/calibration required by Section Two of the AABC or Section II of the NEBB or TABB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.
- E. Verification: The Test and Balance Agency shall recheck ten percent (minimum ten) of the measurements listed in the report. The locations shall be selected by IOR/BMT. The recheck will be witnessed by IOR/BMT. If twenty percent of the measurements that are retested differ from the report and are also out of the specified range, an additional ten percent will be tested. If twenty percent fall outside the specified range, the report will be considered invalid and all test and balance work shall be repeated.
- F. Due to more stringent acoustical requirements in the educational environment, the Test and Balance Agency shall recheck the air systems where the sound level is higher than the specified requirements and demonstrate compliance with the methodology specified in this document with emphasis on fan speed adjustment and balancing for optimum acoustical performance. The recheck will be witnessed by IOR/BMT. When there are multiple air systems, a system selected by IOR/BMT shall be rechecked. If this system is found to be not in compliance, a second system shall be checked. If the second system is also found to be not in compliance, the report will be considered invalid and all test and balance work shall be repeated.

### 3.03 SUBMITTALS

- A. **Submit name of agency to perform the Work.** Include in the submittal the certified **qualifications of all persons** responsible for supervising and performing actual Work

of this Section. Agency shall submit a minimum of five (5) commercial or industrial HVAC system TAB projects of similar type, size, and degree of difficulty completed within the last two years. Agency shall provide name and telephone number of contact person for each listed project.

- B. Submit, for approval, 6 copies of the **Agenda as indicated in Section 3.06** to test and balance all mechanical and relevant plumbing systems.
- C. **Preliminary Report**: Review the Contract Documents, examine Work installations and submit a written report to ARCHITECT and/or IOR/BMT indicating deficiencies in Work precluding proper testing and balancing of the Work.
- D. **Final TAB Report**: Submit the final TAB report for review by ARCHITECT and/or IOR/BMT outlining the conditions and Work completed on each HVAC system. All outlets, devices, HVAC equipment, etc. shall be identified, along with a numbering system corresponding to report unit identification.
- E. **Submit an AABC "National Project Performance Guaranty"** or "NEBB Quality Assurance Certification" assuring the Project systems were tested, adjusted and balanced in accordance with the Specifications and AABC, NEBB or TABB National Standards.
- F. **CADD drawings**: Submit single line, multi-color CADD drawings indicating outside return and supply air, volume control boxes, each outlet and inlet, room numbers, duct sizes at traverse locations, temperatures and pressures, systems balanced, components changed and CONTRACTOR installed access points. In addition, drawings shall identify controls, equipment settings, including manual damper quadrant positions, manual valve indicators, fan speed control levers, and similar controls and devices shall be marked on the drawings to show final settings. CADD files shall be submitted on CD-ROM upon final submittal of TAB report. Reports shall identify discrepancies between completed Work and the Contract Documents affecting the performance and longevity of the system.

### 3.04 GENERAL SCOPE OF WORK

- A. The general scope of Work shall include but not be limited to the following:
  - 1. Measure airflow rates of HVAC systems and make adjustments to achieve design airflow rates, tabulate results and submit reports.
  - 2. Measure water-flow rates of HVAC systems and make adjustments to achieve design water flow rates, tabulate results and submit reports.
  - 3. Measure flow velocities, temperatures, static pressures or head, rotational speed, and electrical power demand of fans, pumps and other related HVAC system components, tabulate results and submit reports.
  - 4. Measure sound levels in each conditioned space, tabulate results and submit reports.

5. Measure ambient sound levels of outdoor HVAC units and system components such as chillers and cooling towers, tabulate results and submit reports.
6. Reports shall contain sufficient data for the system designer to evaluate system performance and solve installation problems such as system pressure profiles and pressure drops across system components

### 3.05 SPECIFIC SCOPE OF WORK

- A. The specific scope of Work shall include the following HVAC system components as indicated on the Drawings:
  1. Air Handling Units
  2. Air Conditioning Units
  3. Heating and Ventilating Units
  4. Heating and Cooling Coils
  5. Supply, Return, Relief and Exhaust Fans
  6. Outside Air and Return Air Plenums
  7. Outside Air Intakes
  8. All Supply and Return Ductwork
  9. All associated Air Terminal Devices, i.e. Supply Diffusers, Return Registers, etc.
  10. Mixing Boxes and Variable Air Volume (VAV) boxes
  11. Reheat Coils (Electric or Hot Water)
  12. Exhaust Duct Systems
  13. Fire and Fire/Smoke Dampers
  14. Kitchen Hoods
  15. Heat Exchangers
  16. Chillers
  17. Boilers
  18. Chilled water, heating hot water pumps

3.06 TESTING, ADJUSTING AND BALANCING AGENDA

- A. Provide proposed materials, methods, procedures, forms, diagrams and reports for test and balance Work.
- B. Agenda to be completed by the test and balance agency and submitted to ARCHITECT and IOR/BMT for review and approval.
- C. Agenda shall include one complete set of AABC, NEBB or TABB publications listed in Section 3.02, B, 2, applicable publications, or, in case of other test and balance agencies and or organizations, comparable publications to establish an approved, systematic and uniform set of procedures.
- D. Agenda shall also include the following detailed narrative procedures, system diagrams and forms for test results:
  - 1. Specific standard procedures required and proposed for each system of the Work.
  - 2. Specified test forms for recording each procedure and for recording sound and vibration measurements.
  - 3. Systems diagrams for each air, water and steam system. Diagrams may be single line.
- E. In addition to information recorded for standard AABC, NEBB or TABB procedures, the following information is required:
  - 1. Fan Data
  - 2. System number, Location, Manufacturer, Model and Serial Number
  - 3. Fan wheel type and size
  - 4. Motor horse power, type and rpm
  - 5. Drive size, type, number of grooves, and open turns on Variable Pitch Drives
  - 6. Number and size of belts, motor and fan shaft sizes, center-to-center of shafts in inches, and adjustment available motor data, including nameplate data, actual amps, rated and actual motor rpm, volts, phase, hp, kW, starter heater size, and capacity
  - 7. Fan design airflow and service (Supply, return, outdoor air or exhaust)
  - 8. Fan static pressure, suction/discharge, static profile and static control point.

- F. The following traverse data is required:
1. Traverse location, size of duct (inside dimensions), Area of duct in square feet
  2. Column for each hole traversed/lines for each reading
  3. Barometric pressure
  4. Temperature/Static Pressure in the duct
  5. Actual CFM corrected to SCFM
  6. Notes
- G. The following air distribution data is required:
1. Room identification
  2. Outlet or intake balance sequence number
  3. Size of outlet or inlet
  4. AK Factor
  5. Design and Actual FPM and CFM
  6. Notes
- H. The following hydronic coil data is required:
1. Air flow through the coil in CFM
  2. Dry bulb and wet bulb temperatures entering/leaving coil
  3. Enthalpy or total heat differences in BTU/lb.
  4. Capacity in BTU/hr at time of test
  5. Water temperature and pressure entering/leaving coil
  6. Flow (in GPM) through coil
  7. Air pressure drop across coil
  8. Water head drop across coil
  9. Notes
- I. The following DX coil data is required:
1. Air flow through the coil in CFM

2. Dry and wet bulb temperatures entering/leaving coil
  3. Enthalpy or total heat difference across coil in BTU/ lb.
  4. Capacity in BTU/hr at time of test
  5. Air pressure drop across coil
  6. Notes
- J. The following data is required for steam to water heat exchangers for heat and/or domestic generation:
1. Exchanger identification number
  2. Nameplate data; manufacturer, model and serial number
  3. Temperature entering/leaving unit
  4. Flow through unit in GPM
  5. Pressure drop through unit
  6. Entering steam pressure
  7. Notes
- K. The following electric heating coil data is required:
1. Heating coil identification number
  2. Nameplate data; manufacturer, model and serial number
  3. Amperage/Voltage on each phase
  4. Phase, kW and Stages
  5. Safety device installed
  6. Air pressure drop across coil
  7. Notes
- L. The following water-cooled chiller data is required:
1. Identification number
  2. Nameplate data; manufacturer, model and serial number
  3. Chilled water flow through evaporator in GPM
  4. Water temperature entering/leaving evaporator

5. Pressure drops through evaporator
  6. Condenser water flow through
  7. Pressure drops through condenser
  8. Water temperature entering/leaving condenser
  9. Motor data, amps, volts, rpm, starter type, overload protection type, phase, hertz, nameplate, and actual measured kW input
  10. Type of refrigerant
  11. Notes
- M. The following cooling tower data is required:
1. Identification number
  2. Nameplate data; manufacturer, model and serial number
  3. Performance test results for rated capacity
  4. Water flow through the tower in GPM
  5. Water temperature entering/leaving tower
  6. Outside Air dry and wet bulb temperatures
  7. Motor data, amps, volts, phase, hertz, and kW input
  8. Starter size and type and heater size and capacity
  9. Water droplets leaving tower - yes/no
  10. Water balanced across tower pans and basins
  11. Airflow across the tower within design rating according to fan curves
  12. Notes
- N. The following boiler and domestic water heater data is required:
1. Performance test results for rated capacity
  2. Boiler identification number
  3. Nameplate data; manufacturer, model and serial number
  4. Water temperature entering/leaving the boiler
  5. Outside conditions: temperature, humidity, general cloud cover



6. Barometric pressure
- O. The following air-cooled split system condensing unit data is required:
1. Performance test results for rated capacity
  2. Unit identification number
  3. Nameplate data, manufacturer, model and serial number.
  4. Compressor nameplate and actual amps, volts, phase, and hertz
  5. RPM of motors, where applicable
  6. Refrigerant type
  7. Suction/Discharge pressure when gauge installed
  8. Number of stages
  9. Low-pressure/High-pressure control setting
  10. Condenser fan sequence stages
  11. Crankcase heater watts (nameplate)
  12. Hot gas bypass installed - yes/no
  13. SCFM Air Flow Measurement vs. Design CFM
- P. The following air-cooled split system heat pump data is required:
1. Performance test results for rated heating and cooling capacities
  2. Unit identification number
  3. Nameplate data, manufacturer, model and serial number.
  4. Compressor nameplate and actual amps, volts, phase, and hertz
  5. RPM of motors, where applicable
  6. Refrigerant type
  7. Suction/Discharge pressure for both heating and cooling modes when gauge installed
  8. Number of stages
  9. Low-pressure/High-pressure control setting
  10. Condenser fan sequence stages

11. Crankcase heater watts (nameplate)
  12. Hot gas bypass installed - yes/no
  13. SCFM Air Flow Measurement vs. Design CFM
- Q. The following sound test data is required:
1. Area or location
  2. Sound level in dB(A) as specified in Section 3.19
  3. Sound level at the center band frequencies of eight non-weighted octaves with equipment on and off for 5 rooms selected by the BMT/IOR.
  4. Plot corrected sound-level reading on Noise Criteria (NC) curve for the measurements in Q 3 above.
- R. The following vibration test data is required:
1. Equipment identification number
  2. Vibration levels at all accessible bearings, motors, fans, pumps, casings, and isolators
  3. Measurements in mils deflection and velocity in inches per second as specified per section XIV of this document
  4. Each measurement taken in horizontal, vertical, and axial planes as accessible.
- S. The following mixing damper leakage test data is required:
1. Equipment identification number (unit, box, zone, etc.)
  2. Dry bulb temperature in the cold/hot (or bypass) deck
  3. Dry bulb temperature in the mixed air stream
  4. Calculated percent leakage
  5. Data above taken in the full cool and full heat (or bypass) mode
  6. Notes
- T. The following airflow station data is required:
1. Station identification number
  2. Nameplate data including effective area
  3. Differential test pressure or velocity

4. Calculated CFM
5. Actual CFM (From Pitot tube traverse form)
6. Read out CFM
7. Notes

U. The following unit heater data is required:

1. Equipment identification number
2. Nameplate data; manufacturer, model and serial number
3. Test CFM (use manufacturer rated CFM if not ducted)
4. Heat test data per applicable procedure (hot water, electric, etc.)
5. Notes

V. The following fan coil and unit ventilator data is required:

1. Equipment identification number
2. Nameplate data; manufacturer, model and serial number
3. Tested supply CFM or manufacturer rated CFM if not ducted
4. Tested outside air in CFM
5. Motor data and actual amps and volts
6. Cooling/Heating test data
7. Static pressure
8. Notes

W. The following kitchen hood data is required:

1. Hood identification number
2. Nameplate data; manufacturer, model and serial number
3. Pitot-tube traverse total air flow
4. Exhaust and supply (when part of hood) CFM
5. Exhaust and supply (when part of hood) test velocities shown on hood face diagram
6. Face velocities

7. Hood opening dimensions
  8. Notes (turbulence and flow patterns at the face and inside the hood)
- X. The following laboratory hood data is required:
1. Hood identification number
  2. Nameplate data; manufacturer, model and serial number
  3. Pitot-tube traverse total air flow
  4. Exhaust and supply (when part of hood) CFM
  5. Exhaust and supply (when part of hood) test velocities shown on hood face diagram
  6. Face velocities
  7. Hood opening dimensions
  8. Notes (turbulence and flow patterns at the face and inside the hood)
- Y. The following data for water-to-water heat exchangers for domestic and/or heating is required:
1. Exchanger identification number
  2. Nameplate data; manufacturer, model and serial number
  3. GPM and Pressure drop through each side
  4. Capacity of each side
  5. Notes
- Z. The following pump data, including but not limited to, chilled water, heating hot water, cooling tower water, boiler feed, domestic hot water booster, domestic hot water circulation, sewage ejectors, sump pumps and domestic hot water booster is required:
1. Pump number
  2. Nameplate data; manufacturer, model and serial number
  3. Motor data including nameplate data, actual amps, volts, RPM, horsepower, starter heater size and capacity
  4. Pump discharge and suction pressure along with total dynamic head in the following modes
  5. Shut-off head FT, Wide open Head FT and Final operating Head FT

6. Final GPM Test plotted on a pump curve
7. Notes

AA. The following water flow station data is required:

1. Station identification number
2. Nameplate data; manufacturer, model, and serial number
3. Design and actual GPM
4. Differential test pressure
5. Setting (open turns, degree, etc.) if required GPM
6. Notes

BB. The following terminal box data is required:

1. Box identification number
2. Node, address or designation on system
3. Box size
4. Cooling CFM
5. Minimum CFM (if applicable)
6. Heating CFM (if applicable)
7. Box fan amps and volts (if applicable)
8. For DDC controlled boxes, record computer readout maximum, minimum, and heat, along with box correction factor for calibrating to true CFM
9. Notes

### 3.07 PROCEDURES

- A. Schedule the Work of this Section in order for test and balance activities to be completed prior to the date of Substantial Completion. CONTRACTOR shall place all heating, ventilating, and air conditioning equipment into operation during each day and until all HVAC adjusting, balancing, testing, demonstrations, and instructions on systems are completed. Agency shall prepare and submit reports within ten (10) days from completion of the Work of this Section to allow sufficient time for corrective measures to be completed before Substantial Completion of the Work. When an individual building or portion thereof is ready for occupancy, all equipment relative to such portion of Work shall be put into service, tested and balanced.

- B. Prior to the date of Substantial Completion, and upon completion of test and balance Work, place all exhaust fans in operation, force all air handling units and air conditioning units into a 100% outdoor air economizer mode with heating and cooling locked out and flush the building continuously for a period of fourteen (14) days.
- C. Coordinate test and balance procedures with any phased Project requirements so test and balance procedures on each phased portion of the Work will be completed prior to completion of said designated phase.

3.08 FIELD EXAMINATION

- A. Before the commencement of test and balance Work, CONTRACTOR shall ascertain that following conditions are fulfilled:
  - 1. Ensure that all water heating and water cooling systems have been flushed, cleaned, filled and high points vented
  - 2. Boilers, steam and hot water, are filled
  - 3. Refrigerant systems are fully charged with specified refrigerant
  - 4. Over-voltage and current protection have been provided for motors
  - 5. Equipment has been labeled as required
  - 6. Curves and descriptive data on each piece of equipment to be tested and adjusted are available as required
  - 7. Operations and maintenance manuals have been supplied
  - 8. Controls manufacturer and boiler-burner representatives shall be available for consultation and supervision of adjustments during tests
  - 9. Verify that heating and cooling coil fins are cleaned and combed and air filters clean and installed
  - 10. Verify that duct systems are clean of debris and leakage is minimized, access doors are closed and duct end caps are in place, fire and volume dampers are in place and open
  - 11. Automatic control systems are completed and operating
  - 12. Start up and initial commissioning of all HVAC equipment except fans shall be by the manufacturer.
- B. In addition to the above, CONTRACTOR shall establish a specific, coordinated plan which details how each area of existing building will be balanced during the various phases of the Work. The evaluation shall address, at a minimum, the following concerns:
  - 1. OWNER operations

2. Building safety and security policies. Prior to any fire safety or security systems shutdown at any time during the Work, CONTRACTOR shall first advise and coordinate with OWNER to ensure all concerned parties are notified.
3. Protecting furniture, computers, photocopiers, and other office equipment.
4. Protecting classroom fixtures and equipment.
5. Concerns specific and unique to building related issues.
6. Downtime required for each AHU including projected time to return each portion of the building back to its normal occupancy temperature and humidity.
7. Shutdown and reactivation of the fire alarm system to avoid accidental alarms during test and balance and related Work.

### 3.09 TEST AND BALANCE

- A. For each heating, ventilating, or air conditioning system specific for the project in hand the following shall be performed, recorded and submitted in an approved format for review. Make, type, and model of unit, and location of each piece of equipment shall be included in the report. Readings shall include but not be limited to following:

1. Air Systems:
  - a. General
    - 1) Verify all ductwork, dampers, grilles, registers, and diffusers have been installed per design and set in the full open position. Agency shall perform the following TAB procedures in accordance with AABC or NEBB National Standards. Where the requirements of the two standards are different, the more stringent requirements shall prevail. Also, if the Contract Documents impose a more stringent standard then the Contract Documents shall prevail.
  - b. Zone, Branch and Main Ducts:
    - 1) Adjust ducts to within design CFM requirements by means of Pitot-tube duct traverse.
  - c. Supply Fans:
    - 1) Fan speeds: Test and adjust fan RPM to achieve maximum or design CFM. CONTRACTOR shall provide new belt pulleys when required.
    - 2) Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits.

Ensure fan motor is not in or above the service factor as published by the motor manufacturer.

- 3) Pitot-Tube Traverse: Perform a Pitot-tube traverse of main supply and return ducts, record total CFM.
  - 4) Outside Air: Test and adjust the outside air using Pitot-tube traverse.
  - 5) Static Pressure: Test and record system static profile of each supply fan.
  - 6) Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits. Ensure fan motor is not in or above the service factor as published by the motor manufacturer.
- d. Return, Relief and Exhaust Fans:
- 1) Fan speeds: Test and adjust fan RPM to achieve maximum or design CFM. CONTRACTOR shall provide new belt pulleys where required.
  - 2) Pitot-Tube Traverse: Perform a Pitot-tube traverse of the main return ducts to obtain total CFM.
  3. Static Pressure: Test and record system static profile of each fan.
- e. VAV Systems:
- 1) Set volume regulators on all terminal boxes to meet design maximum and minimum CFM requirements.
  - 2) Identification: Identify the type, location, and size of each terminal box. This information shall be recorded on terminal box data sheets.
- f. Diffusers, Registers and Grilles:
- 1) Tolerances: Test and balance each diffuser, grille, and register to within 5% of design requirements.
  - 2) Identification: Identify the type, location, and size of each grille, diffuser, and register. This information shall be recorded on air outlet data sheets.
- g. Coils: Air Temperature: Once airflow is set to acceptable limits, agency shall take wet bulb and dry bulb air temperatures on the entering and leaving side of each cooling coil. Dry-bulb temperature shall be taken on the entering and leaving side of each heating coil.



h. Duct Leakage Testing:

- 1) On existing ductwork, agency shall calculate duct leakage by traversing the unit and reading associated diffusers.
- 2) On new installations each and every section of the entire air distribution system (all supply, return, exhaust and relief ductwork) shall be tested at one and one-half times (1-1/2) design static pressure. All ducts shall demonstrate 5% leakage maximum (per CBC 2013 Sec 905.7.3.).

i. Air handling units:

- 1) Prepare pressure profile and show design and actual CFM (outside air, return air, and supply air).
- 2) Measure and record each mode (minimum OA and 100% OA) where economizer cycle is specified.
- 3) Record pressure drops of all components (coils, filters, sound attenuators, louvers, dampers, and fans) and compare with design values.
- 4) Pressure profile and component pressure drops are performance indicators and are not to be used for flow measurements.

j. System Pressure Profiles:

- 1) Prepare pressure profiles from fan (supply, return exhaust) or air handling unit to extremities of system.
- 2) As a minimum, show pressure at each floor, main branch, and airflow, measuring device.
- 3) Make pilot tube traverses of all trunk lines and major branch lines where required for analysis of distribution system. Airflow measuring devices installed in ductwork, if available, may be utilized.
- 4) Record residual pressures at inlets of volume controlled terminals at ends of system.
- 5) Show actual pressures at all static pressure control points utilized for constant or variable flow systems.

k. Fan speed adjustments and balancing for optimum acoustical performance:

- 1) As the very first step, the speed of all fans (supply, return, exhaust, inside packaged equipment or air handling units) shall be adjusted to deliver the required fan total air

quantity with all volume dampers and other flow rate control devices fully open. Adjustments shall be made with the outdoor air intake dampers, return air dampers and relief air dampers in the minimum outdoor air position. The adjustments shall be made again in the 100% outdoor air position in systems with 100% outdoor air economizers.

- 2) The above adjustment shall be done with wet cooling coils where cooling coils are provided.
- 3) The airflow rates at each branch duct shall be adjusted as the second step with air with all volume dampers and other flow rate control devices fully open.
- 4) The airflow rates at each air inlet and outlet shall be adjusted as the final step. The volume damper in the branch duct shall be used for balancing. Opposed blade dampers at air inlets and outlets where provided shall only be used for fine adjustments and shall not be closed beyond 60% open or when the dampers start to generate audible noise.
- 5) CONTRACTOR shall provide the labor and materials for all dampers, pulleys and belt changes required for balancing. The design documents indicate the worst-case scenario with safety factors in fan static pressures for contingency. Properly coordinated and installed air systems may require a lower static pressure and a reduction in fan speed.

2. Water Systems: CONTRACTOR shall confirm all equipment, piping, and coils have been filled and purged, strainers are clean and all balancing valves (except bypass valves) are set full open. Agency shall perform the following TAB procedures in accordance with the AABC, TABB or NEBB National Standards:

B. Pumps:

1. Test and adjust chilled water, hot water, and condenser water pumps to achieve maximum or design GPM.
2. Measure and record suction and discharge pressures.
3. Check pumps for proper operation. Pumps shall be free of vibration and cavitation.
4. Current and Voltage: agency shall test and record motor voltage and amperage, and compare data with the nameplate limits. Ensure pump motor is not in or above the service factor as published by the motor manufacturer.

5. Adjust pump flow by adjusting and setting balancing valves, to obtain amperage reading on a clamp-on ammeter, to correspond to amperage indicated on pump's curves for required flow.
  6. Verify that the motor is not drawing more current than indicated on motor plate rating. When actual flows of primary pumps are found by test to vary more than 5% from specified amount, system shall be re-balanced to regulate flow within this tolerance. When a flow indicating device(s) is in circuit, it shall be used to verify pump flows.
  7. When testing is completed, a pump capacity chart with pump number and location indicated shall be marked indicating operating point of pump on the curve. Chart shall then be included in the report.
- C. Chillers: (Start-up and initial commissioning by manufacturer only.)
1. Test and balance chiller water flows to achieve maximum or design GPM.
  2. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits. Ensure compressor motor is not in or above the service factor as published by the motor manufacturer.
  3. Test and record temperature and pressure profiles of chillers;
    - a. Inlet and outlet water temperature.
    - b. Inlet and outlet water pressure.
    - c. Evaporator temperature.
    - d. Condensing temperature pressure.
    - e. Purge pressure.
    - f. Oil temperature and pressure.
  4. Outside Climatic Conditions: Outside air DB, WB, atmospheric conditions, during temperature profile runs.
- D. Boilers: (Start-up and initial commissioning by manufacturer only.) Test and balance boilers only after test and balance of pumps have been completed. Boilers shall not be initially operated or tests performed with students or faculty on the Project site. Boilers shall be tested for the following:
1. Heating Hot Water Boilers and Domestic Hot Water Boilers:
    - a. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits. Ensure motor is not in or above the service factor.
    - b. Test and balance water flow through water boilers.

- c. Test and record temperature and pressure profiles of water and/or steam boilers.
        - d. Upon completion of tests, controls and devices shall be returned to their normal operating condition and boiler shall remain in service.
  2. Steam Boilers: Start-up and initial commissioning by manufacturer only.
- E. Heat Exchangers:
  1. Steam to Hot Water Heat Exchanger: Steam pressure, entering and leaving hot water temperatures, gpm flow, pressure drop, and control set point.
  2. Water to Water Heat Exchanger:
    - a. Primary Heating Water: Entering and leaving hot water temperatures, gpm flow, and pressure drop.
    - b. Secondary Heated Water: Entering and leaving hot water temperatures, gpm flow, pressure drop, and control set point.
- F. Coils:
  1. Tolerances: Test and balance all chilled-water and hot-water coils within 5% of design requirements.
  2. Verify the type, location, final pressure drop and GPM of each coil.
- G. System Mains and Branches including chilled water, heating hot water, cooling tower water, domestic hot water and domestic cold water:
  1. Balance water flow in pipes to achieve maximum or design GPM.
- H. Steam Heating Systems:
  1. Heating Coils: Steam pressure at coils, cfm, coil pressure drop, entering and leaving air DB temperatures.
  2. Boiler: Steam pressure, temperature and quantity of feed-water (see Testing and Adjusting procedures); boiler make, type, serial number and rated capacity; flue gas temperature at boiler outlet ahead of back-draft diverter; percent carbon dioxide in flue gas; condensate quantities and temperatures.
  3. Air Conditioning Units: (Start-up and initial commissioning by manufacturer only.)
    - a. Suction pressure and temperature.
    - b. Discharge pressure and temperature.

- c. Amps and volts.
  - d. Make, type, and model of unit, capacity rating.
  - e. Ambient temperature: WB, DB
  - f. Supply, return, relief and exhaust fans shall be balanced as indicated in Section 3.09, A, 1, Air Systems.
  - g. Proper operation of controls: Temperature controllers and safety devices shall be tested during operating tests, with all other controls and devices, except one under test, being by-passed.
  - h. Upon completion of tests, controls and devices shall be returned to their normal operating condition and boiler shall remain in service.
4. Condensing and Refrigerating Units: (Start-up and initial commissioning by manufacturer only.)
- a. Suction pressure and temperature.
  - b. Discharge pressure and temperature.
  - c. Amps and volts.
  - d. Make, type, and model of unit, capacity rating.
  - e. Ambient temperature: WB, DB
  - f. Proper operation of controls: Temperature controllers and safety devices shall be tested during operating tests, with all other controls and devices, except one under test, being by-passed.
  - g. Upon completion of tests, controls and devices shall be returned to their normal operating condition and boiler shall remain in service.
5. Split System Heat Pump Units: (Start-up and initial commissioning by manufacturer only.)
- a. Suction pressure and temperature.
  - b. Discharge pressure and temperature.
  - c. Amps and volts.
  - d. Make, type, and model of unit, capacity rating.
  - e. Ambient temperature: WB, DB
  - f. Supply, return, relief and exhaust fans shall be balanced as indicated in Section 3.09. A. 1. Air Systems.

- g. Proper operation of controls: Temperature controllers and safety devices shall be tested during operating tests, with all other controls and devices, except one under test, being by-passed.
  - h. Upon completion of tests, controls and devices shall be returned to their normal operating condition and boiler shall remain in service.
6. MISCELLANEOUS:
- a. Electric Heaters:
    - 1. Amperage.
    - 2. Voltage.
    - 3. Make, type, model, and name plate capacity rating.

### 3.10 VERIFICATION OF HVAC CONTROLS

- A. Agency shall verify in conjunction with CONTRACTOR all control components are installed in accordance with the intent of the Contract Documents and are functioning according to the design intent, including all electrical interlocks, damper sequences, air and water resets, fire stat's, and other safety devices.
- B. CONTRACTOR shall verify all control components are calibrated and set for design operating conditions and intent.

### 3.11 TEMPERATURE TESTING

- A. To verify system control and operation, agency shall perform a series of three temperature tests taken at approximately two-hour intervals in each separately controlled zone. The resulting temperatures shall not vary more than two (2) degrees Fahrenheit from the thermostat or control set point during the tests. Outside temperature and humidity shall also be recorded during the testing periods.

### 3.12 KITCHEN HOOD TESTING

- A. Agency shall test and adjust hood total airflow by duct Pitot-tube traverse. If a Pitot-tube traverse is not practical, an explanation of why a traverse was not made must be made in writing to Architect and subsequently appear on the appropriate data sheet. Face velocities shall be tested under design operating conditions using a maximum of a one square foot grid pattern across the entire open face. CONTRACTOR shall set sash height on hoods to obtain face velocities within 20% of 100 feet per minute unless specified otherwise. Agency shall test and adjust exhaust airflows and make-up air flows to maintain design hood pressures and face velocities, and design room pressurization. Agency shall test for turbulence and proper air flow patterns at the face and inside the hoods using a hand-held smoke puffer or other approved smoke-emitting device.

3.14 BUILDING/ZONE PRESSURIZATION

- A. Agency shall test and adjust building/zone pressurization by setting the design flows to meet the required flow direction and pressure differentials. Positive/Negative area(s) supply air shall be set to design flow and exhaust air rates adjusted to obtain the required pressure differential(s).

3.15 FIRE AND SMOKE DAMPER TESTING

- A. This work is to be performed by OWNER and State Fire Marshall. Do not include in agency scope of work.

3.16 LIFE SAFETY CONTROLS TESTING

- A. This work is to be performed by OWNER and State Fire Marshall. Do not include in agency scope of Work.

3.17 FINAL TABULATION

- A. After heating, ventilating, and air conditioning components are satisfactorily tested and balanced, entire system shall be put into operation and all pressures, temperatures, gpm, cfm, velocities, etc., shall be recorded and checked against design schedules. Design requirements shall be listed on reports and final tabulation shall be within a tolerance of plus or minus 5% of design requirements.
- B. Readings at various locations as described herein will be made every hour for four (4) hours, during normal working hours for three (3) days. Boilers, forced air furnaces and chillers shall be started up far enough in advance to meet design conditions during period of testing.

3.18 VIBRATION TESTING

- A. Furnish instruments and perform vibration measurements if specified in Division 15. Provide measurements for all rotating HVAC equipment half horsepower and larger, including reciprocating/centrifugal/screw/scroll compressors, pumps, fans and motors.
- B. Record initial and final measurements for each unit of equipment on test forms. Where vibration readings exceed allowable tolerance and efforts to make corrections have proved unsuccessful, forward a separate report to ARCHITECT.

3.19 SOUND TESTING

- A. Perform and record sound measurements as specified in this section and if specified in Section 15070: Sound Vibration and Seismic Control. Take additional readings if required by ARCHITECT.
- B. Take measurements with a calibrated Type 1 sound level meter and octave band analyzer.
- C. Sound reference levels, formulae and coefficients shall be according to ASHRAE handbook, Current Systems Volume; Chapter: Sound and Vibration Control.

- D. Determine compliance with the Contract Documents as follows:
1. Where sound pressure levels are specified as noise criteria or room criteria in Section 15070: Sound, Vibration and Seismic Control.
    - a. Reduce background noise as much as possible by shutting off unrelated audible equipment.
    - b. Measure octave band sound pressure levels with specified equipment "off".
    - c. Measure octave band sound pressure levels with specified equipment "on".
    - d. Use difference in corresponding readings to determine sound pressure due to equipment.

DIFF.:	0	1	2	3	4	5	9-10 or More
FACTOR:	10	7	4	3	2	1	0
    - e. Plot octave bands of sound pressure level due to equipment for typical rooms, on a graph, which also shows, noise criteria (NC) curves.
  2. When sound power levels are specified:
    - a. Perform steps in Section 3.19, D, 1.a. through 1.d.
    - b. For indoor equipment: Determine room attenuating effect; i.e., difference between sound power level and sound pressure level. Determine sound power level will be sum of sound pressure level due to equipment, plus room attenuating effect.
    - c. For outdoor equipment: Use directivity factor and distance from noise source to determine distance factor, i.e., difference between sound power level and sound pressure level. Measured sound power level will be sum of sound pressure level due to equipment, plus distance factor.
  3. Where sound pressure levels are specified in terms of dbA, measure sound levels using the "A" scale of meter. Single value readings will be used instead of octave band analysis.
- E. Where measured sound levels exceed specified level, CONTRACTOR shall take all remedial action and necessary sound tests shall be repeated.
- F. Measure and record sound levels in decibels at each diffuser, grille or register in occupied areas. Sound levels shall be measured approximately 5'-0" above floor on a line approximately 45 degrees to center of opening, on the "A" and "C" scales of a General Radio Company sound level meter, or similar instrument.



- G. Report shall also include ambient sound levels of rooms in which above openings are located, taken without air-handling equipment operating. A report shall also be made of any noise caused by mechanical vibration.

END OF SECTION 018620

## **SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION**

- A. Commissioning: Commissioning is a systematic process of ensuring that all building systems perform interactively according to the owner's project requirements and operational needs. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing adjusting and balancing, performance testing and training.
- B. Commissioning during the construction phase is intended to achieve the following specific objectives:
  - 1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors
  - 2. Verify and document proper functional performance of equipment and systems
  - 3. Verify that O&M documentation left on site is complete.
  - 4. Verify that the Owner's operating personnel are adequately trained.

#### **1.2 RELATED WORK**

- A. Division 01 - General Requirements
  - 1. Section 01 33 00 - Submittal Procedures
  - 2. Section 01 77 00 - Closeout Procedures
- B. Division 22 - Plumbing
  - 1. Section 22 08 00 - Commissioning of Plumbing
- C. Division 23 - Mechanical
  - 1. Section 23 08 00 - Commissioning of Mechanical
- D. Division 26 - Electrical
  - 1. Section 26 08 00 - Commissioning of Electrical Systems
- E. Division 32 - Exterior Improvements
  - 1. Section 32 08 00 - Commissioning of Exterior Improvements

### **1.3 ABBREVIATIONS AND DEFINITIONS**

- A. A/E: Design Professional
- B. ASI: Architectural Supplemental Instruction
- C. BAS: Building Automation System
- D. BoD: Basis of Design. A narrative of how the designer plans to achieve the OPR
- E. CxA: Commissioning Authority
- F. CxS: Commissioning Supervisor
- G. CC: Controls Contractor
- H. CM: Construction Manager / Owner Project Manager
- I. Cx: Commissioning
- J. CxA: Commissioning Authority
- K. CxS: Commissioning Supervisor
- L. Cx Plan: Commissioning Plan
- M. Cx RFI: Commissioning Request for Information
- N. DDC: Direct Digital Control System
- O. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents and cannot be corrected in five (5) minutes time.
- P. EC: Electrical Contractor
- Q. FBO: Furnished By Others
- R. FT: Functional Performance Test
- S. GC: General Contractor
- T. IAW: In Accordance With
- U. MC: Mechanical Contractor
- V. O & M: Operation and Maintenance

- W. OPR: Owner Project Requirement. A dynamic document expressing how the owner expects the building systems to perform upon project completion.
- X. PC: Prefunctional Checklist
- Y. RFI: Request for Information
- Z. SI: Systems Integration Contractor
- AA. Sub(s): Subcontractors or Prime Contractor
- BB. TAB: Test, Adjust and Balance
- CC. TBD: To Be Determined

#### **1.4 EQUIPMENT AND SYSTEMS TO BE COMMISSIONED**

- A. The specific systems that shall be commissioned include:
  - 1. Plumbing Systems (and all integral equipment controls)
    - a. Domestic Potable Water Meter
    - b. Electric Instantaneous Water Heater
  - 2. Mechanical Systems (and all integral equipment controls)
    - a. Heating Hot Water BTU Meter
    - b. Chilled Water BTU Meter
    - c. Variable Air Handling Units
    - d. Variable Air Volume Terminal Units w/ Heating Hot Water Coils
    - e. Fan Coil Units
    - f. General Building Exhaust Fans
    - g. Dust Collector
    - h. Building Automation System
  - 3. Electrical Systems (and all integral equipment controls)
    - a. Exterior & Interior Lighting
    - b. Smart Meter - Main Switchboard (4DB1)
    - c. Emergency Power Inverter Lighting
    - d. Light Control System
  - 4. Exterior Improvement Systems (and all integral equipment controls)
    - a. Landscape Irrigation System (8 zones)

## **1.5 COMMISSIONING TEAM COORDINATION**

- A. **Members:** The members of the commissioning team consist of the Commissioning Authority (CxA), the CM facilities personnel, the CxS, the MC, the EC, the TAB representative, the SI, and any other installing Subs or suppliers of equipment. In addition, representatives of the A/E team are also commissioning team members and are invited to observe critical procedures and attend Cx coordination meetings.
- B. **Management:** The CxA is hired by the Owner and directs and coordinates the commissioning activities and reports to the CM. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents.
- C. **Scheduling:** The CxA shall work with the GC, according to established protocols, to project an initial commissioning schedule. The GC shall integrate the tentative commissioning schedule into the master schedule. All parties shall address scheduling problems and make necessary notification in a timely manner in order to expedite the commissioning process. The functional testing will not begin until the CxA is notified in writing by the GC that all prefunctional checklists have been completed and the Subcontractors have functionally tested the systems.
1. The CxA will provide the initial schedule of primary commissioning events at the commissioning scoping meeting. As construction progresses, more detailed schedules are developed by the CxA and GC.
- D. **Facility Grid:** The CxA utilizes Facility Grid, cloud-based and mobile commissioning software platform to execute commissioning activities and deliverables. <https://facilitygrid.com/> CxA will provide project team members introduction to Facility Grid's platform. Facility Grid will allow CxA, facility managers, architects, contractors, maintenance personnel, and corporate administrators can actually see and operate in the same loop real time. This transparency opens the door to major short and long-term efficiencies in all phases of the facilities management process. Facility Grid defines the future of commissioning software by increasing the efficiency of commissioning agents, by streamlining commissioning projects and record keeping, by enabling project managers to see the big and small pictures in real time, across all projects, and by providing owners with a database of building information to benefit from today and in the future.
1. Real-Time Collaboration
  2. Transparency
  3. Team Engagement
  4. Accountability
  5. Information Sustainability

## **1.6 SUBMITTALS**

- A. **The GC shall provide the CxA a list of required equipment/system submittals to the CxA.** The CxA will identify submittals to be submitted to the CxA concurrent with submission to the A/E for review.

- B. All Subs, through the GC, shall submit required installation, start-up, and preventive maintenance equipment data sheets to the CxA within 45 days of equipment approval by the A/E.
- C. All Subs, through the GC, shall submit O&M data for system and equipment being commissioned under this specification. O&M data shall be submitted within 45 days of equipment approval by the A/E, but no less than 8 weeks prior to the beginning of functional testing.
- D. The GC shall submit a copy of the construction meeting minutes, updated construction schedule, RFI log, and ASI log to the CxA within seven days of each meeting or update.

## **PART 2 - PRODUCTS**

### **2.1 TEST EQUIPMENT**

- A. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Division contractor for the equipment being tested. For example, the mechanical contractor of Division 23 shall ultimately be responsible for all standard testing equipment for the HVAC and control systems in Division 23.
- B. Special equipment, tools, instruments, and setup software (only available from vendor/Subs, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be provided by the Contractor and left on site, for the CxA and their test/adjust/balance (TAB) firm to use during TAB, functional testing, seasonal testing, and deferred testing. The equipment, tools, instruments, and setup software will be returned to the vendor/Subs after successful conclusion of the commissioning effort.
- C. The controls contractor shall provide the CxA with temporary software license to be loaded on the CxA's and/or TAB firm's computer, and any necessary network connection cables, for accessing the direct digital control system field panels for system testing. The controls contractor shall also provide a palm device with attachments, software, and cables, to check setpoint values of terminal device controllers. The controls contractor shall provide the CxA with log-on ID, password, and modem phone number for remote dial-in connection to direct digital control system. All of the software, cables, and modems provided to the CxA will be returned at the successful conclusion of the commissioning effort.

- D. All testing equipment used by the contractors shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements shall apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to accuracy of 0.1°F and a resolution of +/- 0.1°F. Humidity sensors shall have a certified calibration within the past 6 months and a resolution of +/- 1%. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. Accuracy of other sensors shall be at least twice that of the instrumentation being tested. All equipment shall be calibrated according to the manufacturer's recommended intervals, in addition to just after being dropped or damaged. Calibration tags shall be affixed or certificates readily available.

## **PART 3 - EXECUTION**

### **3.1 COMMISSIONING PROCESS**

- A. The following narrative provides an overview of the commissioning tasks during construction and the general order in which they occur.
1. Commissioning during construction begins with a scoping meeting conducted by the CxA where the commissioning process and the draft Cx Plan is reviewed with the commissioning team members. After this meeting, the draft Cx Plan, which is initially provided prior to the scoping meeting, is then updated with the project specific communication protocols, Cx team contact information, and the preliminary commissioning schedule, which is developed during the scoping meeting.
  2. Additional meetings will be conducted as needed throughout construction. The CM, CxA and GC will schedule these meetings with necessary parties attending. The meetings will be conducted in order to plan, scope, coordinate, schedule future activities and resolve problems. In general, the commissioning meetings will be held monthly during the construction period.
  3. Equipment documentation is submitted to the CxA, concurrent with the normal submittals to the A/E, including detailed pre-startup checklists and startup procedures. Specific submittals requirements are detailed as referenced above, and in Subsection 1.06 above.
  4. The CxA works with the GC and its Subs in developing startup plans and startup documentation formats, including providing the Subs with prefunctional checklists to be completed, during the startup process. The prefunctional checklists are developed by the CxA for the equipment listed in Subsection 1.04 above, using the A/E approved submittals.
  5. In general, the checkout and performance verification proceeds from simple to complex, from component level to equipment to systems and intersystem levels with prefunctional checklists being completed before functional testing.
  6. The CxA will review shop drawings and material certifications, review reports from independent testing agencies, conduct independent on-site periodic construction observation and attend selected quality control-related and construction progress meetings.

7. The Subs, under their own direction, execute and document the prefunctional checklists and perform startup and initial checkout. The CxA documents that the checklists and startup were completed by the Subs. This will include the CxA witnessing start-up of selected equipment.
8. The CxA develops specific equipment and system functional performance test procedures. The CxA submits the proposed functional tests to the CM, A/E and GC for their review and comment, and provides a copy of the proposed functional tests to the responsible Sub who shall review the tests for feasibility, safety and equipment warranty protection.
9. O&M data is submitted to the CxA prior to execution of functional tests. The CxA reviews the documentation for completeness. The CxA also uses the documentation for reference during the functional testing.
10. Manufacturers will perform and document all specified Factory Testing and start-up. Copies of test reports are provided to the A/E and CxA for review.
11. The functional test procedures are executed by the contractor, under the direction of, and documented by the CxA.
12. Items of non-compliance in material, installation or startup are corrected at the Sub's expense and the system retested.
13. The CxA reviews and pre-approves the training provided by the Subs and verifies that it was satisfactorily completed.
14. Commissioning is completed before owner occupancy/use.
15. Deferred testing is conducted, as specified in these specifications.

### **3.2 RESPONSIBILITIES**

#### **A. General Contractor**

1. Shall verify completeness of the building envelope, perimeter and interior items, which affect proper operation and control of equipment and systems.
2. Shall schedule and coordinate participation and cooperation of all subcontractors required for the commissioning process.
3. Shall incorporate commissioning tasks into the master construction schedule.
4. Shall be responsible for providing written responses to the CxA's submittal review comments.
5. Shall provide a Commissioning Supervisor (CxS) who will be responsible for communication between each individual contractor/subcontractor and the CxA. This representative shall be responsible to: coordinate meetings, plan and schedule Cx activities into the project schedule, distribute Cx documentation to responsible contractors, receive written notification from contractors that Cx issues are corrected, perform corrective actions for resolution of deficiencies, and handle required submittals to the CxA.
6. Review and approve the completion of the PCs, then notify the CxA that functional testing can proceed.
7. Ensure Installing Contractors or their Vendors provide all specialized tools or the use of specialized tools that may be required to start, check-out and functionally test equipment and systems.
8. Shall meet requirements of other commissioning requirements within the Project Manual.



9. Shall schedule and coordinate participation and cooperation of all subcontractors and vendors in owner training.
10. Shall provide final operation and maintenance documentation in formats required including submission in scanned digital media format. Provide to CxA for the required Systems Manual.

**B. Subcontractors/Suppliers**

1. Shall be responsible for providing labor, material, equipment, etc., required within the scope of their specialty to implement and facilitate the commissioning process.
2. Shall include all special tools, software, and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these contract documents in the base bid price to the contractor, except for stand-alone data-logging equipment that may be used by the CxA.
3. Shall demonstrate the operation of the equipment and systems is per the contract documents.
4. Shall assist the GC in the development of the master schedule as relates to commissioning and milestones.
5. Shall respond in writing to written submittal review comments by the CxA.
6. Shall respond in writing as to the completion or resolution of each issue in the commissioning issue log.
7. Shall meet requirements of other commissioning requirements within the Project Manual.
8. Shall provide to GC and CxA information required for the Systems Manual per CALGreen criteria.

**C. Owner**

1. Schedules the participation of facilities personnel in the commissioning process in writing.
2. Advises the CxA of any changes to the building's use or occupancy.

**3.3 MEETINGS**

- A. **Scoping Meeting:** The CxA will schedule, plan, and conduct a commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties by the CxA within two weeks after the meeting. Information gathered from this meeting will allow the CxA to revise the Commissioning Plan to its "final" version.
- B. **Miscellaneous Meetings:** Other meetings will be planned and conducted by the CxA as construction progresses. These meetings will cover coordination, deficiency resolution, and planning issues with particular subcontractors.

### **3.4 START-UP, PRE-FUNCTIONAL CHECKLISTS, AND INITIAL CHECKOUT**

- A. The following procedures apply to all equipment and building systems to be commissioned, according to Subsection 1.4, EQUIPMENT AND SYSTEMS TO BE COMMISSIONED. Some systems that are not comprised so much of actual dynamic machinery, e.g., electrical system power quality, may have very simplified PCs and start-up.
- B. General. Prefunctional checklists are important to ensure that the equipment and systems are completely installed and integrated with other building components and systems, hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment or assembly receives full Prefunctional checkout. No sampling strategies are used. The Prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of the equipment or subsystems of the given system.
- C. Start-up and Initial Checkout Plan. The CxA shall assist the commissioning team members responsible for start-up of any equipment in developing detailed start-up plans for all equipment. The primary role of the CxA in this process is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed. Parties responsible for Prefunctional checklists and start-up are identified in the commissioning scoping meeting and in the checklist forms. Parties responsible for executing functional performance tests are identified in the testing requirements in Specification Sections 220800, 230800, 260800, 320800 and any other sections where test requirements are found.
1. The CxA generates generic and representative Prefunctional checklists and procedures as required in Specification Sections 220800, 230800, 260800 and 320800. These checklists will indicate required procedures to be executed as part of start-up and initial checkout of the systems and the party responsible for their execution.
  2. These generic checklists and tests are provided by the CxA to the Contractor. The Contractor determines which trade is responsible for executing and documenting each of the line item tasks and notes that trade on the form. Each procedure and associated forms may have more than one trade responsible for its execution.
  3. The subcontractor responsible for the purchase of the equipment develops the full start-up plan by combining (or adding to) the CxA's checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines/fields for recording and documenting the checking and inspections of each procedure and a summary statement with an initial block/ "completed by" associated with each procedure. The responsible party marks the applicable areas in the procedures and makes initial and date lines at each test procedure.
  4. The full start-up plan could consist of something as simple as:
    - a. The CxA's prefunctional checklists.
    - b. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
    - c. The manufacturer's normally used field checkout sheets.
  5. The subcontractor submits the full start-up plan to the CxA for review and approval.

6. The CxA reviews and approves the procedures and the format for documenting them, noting any procedures that need to be added.
7. The full start-up procedures and the approval form may be provided to the CM for review and approval, depending on management protocol.

### **3.5 FUNCTIONAL PERFORMANCE TESTING**

- A. The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing facilitates bringing the systems from a state of material completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.
- B. In general, each system shall be operated through all modes of operation where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions shall also be tested. Specific modes required in this project are given in Specification Sections 220800, 230800, 260800, 320800 and any other sections where test requirements are found.
- C. The CxA shall review Owner-contracted, factory testing or required Owner acceptance tests which the CxA is not responsible to oversee, including documentation format, and shall determine what further testing or format changes may be required to comply with the Specifications. Redundancy of testing shall be minimized.
- D. The Subs shall provide sufficient notice to the CxA regarding their completion schedule for the Prefunctional checklists and start-up of all equipment and systems. The CxA will schedule functional tests through the CM, GC, and affected subs. The CxA shall direct, witness and document the functional testing of all equipment and systems. The CxA shall generally execute most standard tests with initial participation of the affected subs.

### **3.6 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS**

- A. Documentation: The CxA will witness and document the results of all functional performance tests using the specific functional checklist forms developed for that purpose. Prior to testing, these forms are provided to the A/E, CM and Subs for review.
- B. Non-Conformance
  1. The CxA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues will be noted and reported to the CM in writing.
  2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented.

3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the CM. A test shall be aborted if any system deficiency prevents the successful completion of the test or if any participating contractor team member of which participation is specified is not present for the test.
4. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing contractor.
  - a. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:
    - 1) The CxA documents the deficiency and the Sub's response and intentions and they go on to another test or sequence. After the day's work, the CxA submits the non-compliance reports to the CM for signature, if required. A copy of the deficiencies is provided to the GC and Subs. The Sub corrects the deficiency, then signs-off that the correction has been made, certifying that the equipment is ready to be retested and sends it back to the CxA.
    - 2) The CxA reschedules the test and the test is repeated.
  - b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
    - 1) The deficiency shall be documented, along with the Sub's response, and a copy given to the CM, the GC and to the Sub representative assumed to be responsible.
    - 2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the CM.
    - 3) The CxA documents the resolution process.
    - 4) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs-off that the correction is complete, and provides the written sign-off to the CxA. The CxA and GC shall reschedule the test, and the test is repeated.
5. Cost of Retesting
  - a. The cost for the Sub to retest a prefunctional or functional test, if they are responsible for the deficiency, shall be theirs.
  - b. The time and expenses for the CxA to direct any retesting, above one retest, required because a specific prefunctional checklist or start-up test item, reported to have been successfully completed, but determined during functional testing to be faulty, will be backcharged to the GC, who may choose to recover costs from the responsible Sub.

6. The GC shall respond in writing to the CxA and CM at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.
  7. Any required retesting by any contractor shall not be considered a justified reason for a claim of delay or for a time extension by the prime contractor.
- C. Failure Due to Manufacturer Defect: If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the GC, the CM, the A/E, or the CxA. In such case, the responsible Sub shall provide the Owner with the following:
1. Within one week of notification from the CM, the Sub or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the CM within two weeks of the original notice.
  2. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
  3. The CM will determine whether a replacement of all identical units or a repair is acceptable.
  4. Two examples of the proposed solution shall be installed by the Sub and the CM will be allowed to test the installations for up to one week, upon which the CM will decide whether to accept the solution.
  5. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.
  6. The time and expenses for the CxA to direct any retesting, above one retest, required because of an equipment failure, will be backcharged to the GC, who may choose to recover costs from the responsible Sub. An example would be motor failures in series powered terminal induction units. Once all motors have been replaced, prefunctional checklists completed, and documents submitted that all repairs and corrections have been completed; the CxA will direct one retest. If any failures occur during the retest, the CxA will backcharge the GC for additional testing.
- D. Approval: The CxA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CxA, if necessary. The CxA recommends acceptance of each test to the CM. The CM gives final approval on each test.

### **3.7 OPERATION AND MAINTENANCE MANUALS**

- A. Standard O&M Manuals.

1. The specific content and format requirements for the standard O&M manuals are detailed in Section 01 77 00. Special requirements for TAB contractor in appropriate Division 23 Sections and for the Controls Contractor are found in appropriate Division 23 Sections. Electrical requirements are located in the appropriate Division 26 Sections. A/E Contribution. The A/E will include in the beginning of the O&M manuals a separate section describing the systems including:
  - a. The design intent narrative prepared by the A/E, updated to as-built status by the A/E.
  - b. Simplified professionally drawn single line system diagrams on 8 ½" x 11" or 11" x 17" sheets. These shall include chilled water distribution system, water system, condenser water system, heating system, supply air systems, and exhaust systems and others as designated. These shall show major pieces of equipment such as pumps, heat exchangers, humidifiers, control valves, expansion tanks, coils, service valves, etc.
  - c. Completed Testing, Adjusting and Balancing reports.
  - d. As-built sequences of operations for all equipment including detailed sensor ranges and initial setpoints.
  - e. Seasonal operational guidelines by the equipment and system manufacturer.
  - f. Data sheets for all sensors and actuators by type and use for the equipment and systems including recommendations for recalibration.
  - g. Troubleshooting and diagnostic information for all equipment and systems.
  - h. Preventative maintenance procedures for all equipment and systems.
2. CxA Review and Approval. Prior to material completion, the CxA shall review the O&M manuals, documentation and redline as-builds *for systems that were commissioned* and list other systems documentation that the CxA should review to verify compliance with the *Specifications*. The CxA will communicate deficiencies in the manuals to the CM or A/E, as requested. Upon a successful review of the corrections, the CxA recommends approval and acceptance of these sections of the O&M manuals to the CM or A/E. The CxA also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are clearly stated. This work does not supersede the A/E's review of the O&M manuals according to the A/E's contract.

### **3.8 TRAINING OF OWNER PERSONNEL**

- A. The GC shall be responsible for training coordination and scheduling and ultimately for ensuring that training is complete.
- B. The CxA will be responsible for overseeing and approving the adequacy of the training of Owner personnel for commissioned equipment.
  1. Instructor capabilities shall be commensurate with level of instruction required. Instructor qualifications shall be submitted to Owner and CxA for review prior to training.
  2. The specific training requirements of Owner personnel by Subs and vendors are specified in Divisions 01, 22, 23, 26 and 32.

3. Each Sub and vendor responsible for training shall submit a written training plan to the CxA for review and approval prior to training. The plan shall include the following elements:
  - a. Equipment (included in training)
  - b. Intended audience
  - c. Location of training
  - d. Objectives
  - e. Subjects covered (description, duration of discussion, special methods, etc.)
  - f. Duration of training on each subject
  - g. Instructor name and qualifications for each subject
  - h. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)
  
4. The CxA develops criteria for determining that the training was satisfactorily completed, including attending some of the training, etc. The CxA recommends approval of the training to the CM.

### **3.9 DEFERRED TESTING**

- A. Unforeseen Deferred Tests: If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the CM, A/E and CxA. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.
  
- B. Seasonal Testing: During the warranty period, seasonal testing shall be completed as part of this contract. Seasonal testing is intended to test the performance of systems under full load conditions that cannot be simulated during the functional testing period. For example, it is impossible to test the heating system under full load conditions in July, so the heating system would be full load tested during the winter months. The CxA will coordinate this activity. Tests will be executed, documented, and deficiencies corrected by the appropriate Subs, with facilities staff and the CxA witnessing. The GC and its Subs will make any final adjustments to the O&M manuals and as-builts due to this testing.

**END OF SECTION 01 91 13**

## SECTION 024115 - SELECTIVE DEMOLITION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and other Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Demolition and removal of selected portions of building or structure.
  - 2. Demolition and removal of selected site elements.
  - 3. Salvage of existing items to be reused or recycled.
- B. Related Sections include the following:
  - 1. Division 1 Section "Summary" for use of premises, and phasing, and Owner-occupancy requirements.
  - 2. Division 1 Section "Photographic Documentation" for preconstruction photographs taken before selective demolition operations.
  - 3. Division 1 Section "Construction Facilities and Temporary Controls" for temporary construction and environmental-protection measures for selective demolition operations.
  - 4. Division 1 Section "Construction Waste Management" for disposal of demolished materials.
  - 5. Division 1 Section "Execution Requirements" for cutting and patching procedures.

#### 1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse. Contractor to coordinate these items with the BMT.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.



- D. 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.

#### 1.4 SUBMITTALS

- A. Qualification Data: For demolition firm, professional engineer, and refrigerant recovery technician.
- B. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- C. Pre-demolition Photographs or Videos: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations. Comply with Division 1 Section "Photographic Documentation." Submit before Work begins.
- D. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
  - 1. Comply with submittal requirements in Division 1 Section "Construction Waste Management."

#### 1.5 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI A10.6 and NFPA 241.
- E. Pre-demolition Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:
  - 1. Inspect and discuss condition of construction to be selectively demolished.
  - 2. Review structural load limitations of existing structure.
  - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
  - 5. Review areas where existing construction is to remain and requires protection.

## 1.6 PROJECT CONDITIONS

- A. Owner will occupy portions of site and buildings immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
  - 1. Comply with requirements specified in Division 1 Section "Summary."
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: Hazardous materials may be encountered in the Work.
  - 1. Hazardous materials will be removed by the Contractor under this Contract before start of the Work.
  - 2. If materials suspected of containing hazardous materials are encountered that are not identified within the Contract Documents, do not disturb; immediately notify Architect, BMT and Owner. Contractor will remove hazardous materials under this contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.

## 1.7 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.

- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
- F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or preconstruction videotapes.
  - 1. Comply with requirements specified in Division 1 Section "Photographic Documentation."
  - 2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.
- G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

### 3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
  - 1. Comply with requirements for existing services/systems interruptions specified in Division 1 Section "Summary."
- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
  - 2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  - 3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
    - a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

### 3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  - 1. Comply with requirements for access and protection specified in Division 1 Section "Construction Facilities and Temporary Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
  - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
  - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
  - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 1 Section "Construction Facilities and Temporary Controls."
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
  - 1. Strengthen or add new supports when required during progress of selective demolition.

### 3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
  - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
  - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
  - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents

of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.

5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly. Comply with requirements in Division 1 Section "Construction Waste Management."

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by BMT and the Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

### 3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

### 3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
  - 4. Comply with requirements specified in Division 1 Section "Construction Waste Management."
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

### 3.7 CLEANING

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

END OF SECTION 024115

## **SECTION 02 41 16 – STRUCTURE DEMOLITION GENERAL**

### **1.1 SUMMARY**

- A. This Section includes demolition and removal of the following:
  - 1. Buildings and structures
  - 2. Site improvements including site utilities.
  - 3. Protecting existing trees, shrubs, plants and grass to remain.
  - 4. Clearing and grubbing.
  - 5. Stripping and stockpiling topsoil.
  - 6. Removing above- and below-grade site improvements.
  - 7. Disconnecting and capping or sealing site utilities.
  - 8. Temporary erosion and sedimentation control measures.
- B. See Division 23 Sections for demolishing or relocating site mechanical items.
- C. See Division 26 Sections for demolishing or relocating site electrical items.

### **1.2 DEFINITIONS**

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or recycled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
- C. 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 recycled.

### **1.3 MATERIALS OWNERSHIP**

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, [Insert description of other items] antiques, and other items of interest or value to Owner that may be encountered during demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

### **1.4 SUBMITTALS (Not Applicable)**

### **1.5 QUALITY ASSURANCE**

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI A10.6 and NFPA 241.
- C. Predemolition Conference: Conduct conference at Project site.

## 1.6 PROJECT CONDITIONS

- A. Buildings to be demolished will be vacated and their use discontinued before start of Work.
- B. Owner assumes no responsibility for buildings and structures to be demolished.
  - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
  - 1. Hazardous materials will be removed by Owner before start of the Work.
  - 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- D. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- E. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- F. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- G. Do not commence site-clearing operations until temporary erosion and sedimentation control measures are in place.

## 1.7 COORDINATION

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



## **PART 2 - PRODUCTS (Not Applicable)**

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Survey existing conditions and correlate with requirements indicated to determine extent of building and site demolition required.
- B. Review Project Record Documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Inventory and record the condition of items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element. Promptly submit a written report to Architect.

### **3.2 PREPARATION**

- A. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
  - 1. Arrange to shut off indicated utilities with utility companies.
  - 2. If utility services are required to be removed, relocated, or abandoned, before proceeding with building demolition provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
  - 3. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
- B. Existing Utilities: Refer to Division 23 and 26 Sections for shutting off, disconnecting, removing, and sealing or capping mechanical or electrical utilities. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.
- C. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
- D. Removed and Salvaged Items: Comply with the following:
  - 1. Clean salvaged items of dirt and demolition debris.
  - 2. Pack or crate items after cleaning. Identify contents of containers.
  - 3. Store items in secure area until delivery to Owner.
  - 4. Transport items to Owner's storage area designated by Owner
  - 5. Protect items from damage during transport and storage.

- E. Protect and maintain benchmarks and survey control points from disturbance during construction.
- F. Locate and clearly flag trees and vegetation to remain or to be relocated.
- G. Protect existing site improvements to remain from damage during construction.
  - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

### **3.3 TEMPORARY EROSION AND SEDIMENTATION CONTROL**

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction and sediment and erosion control Drawings.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

### **3.4 TREE PROTECTION**

- A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
- B. Do not excavate within tree protection zones, unless otherwise indicated.
- C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

### **3.5 PROTECTION**

- A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations.
- B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during demolition and cleaned and reinstalled in their original locations after demolition operations are complete.
- C. Existing Utilities: Maintain utility services indicated to remain and protect them against damage during demolition operations.
  - 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.

2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
  - a. Provide at least 72 hours notice to Owner if shutdown of service is required during changeover.
- D. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Division 1 Section "Temporary Facilities and Controls."
  1. Protect existing site improvements, appurtenances, and landscaping to remain.
  2. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
  3. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
  4. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.

### 3.6 DEMOLITION, GENERAL

- A. General: Demolish indicated existing buildings, structures, and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
  1. Do not use cutting torches until work area is cleared of flammable materials. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
  2. Maintain adequate ventilation when using cutting torches.
  3. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Engineering Surveys: Perform surveys as the Work progresses to detect hazards that may result from building demolition activities.
- C. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
  2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

### 3.7 MECHANICAL DEMOLITION

- A. Remove buildings, structures, and site improvements intact when permitted by authorities having jurisdiction.
- B. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on next lower level.
- C. Remove debris from elevated portions by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
  - 1. Remove structural framing members and lower to ground by method suitable to minimize ground impact or dust generation.
- D. Concrete: Cut concrete full depth at junctures with construction indicated to remain.
- E. Masonry: Cut masonry cleanly at junctures with construction indicated to remain.
- F. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished at junctures with construction indicated to remain, then break up and remove.
- G. Below-Grade Construction: Demolish foundation walls and other below-grade construction.
  - 1. Remove below-grade construction, including basements, foundation walls, and footings, completely.
- H. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within 5 feet outside of footprint indicated for new construction. Abandon utilities outside this area.
  - 1. Fill abandoned utility structures with satisfactory soil materials according to backfill requirements in Division 2 Section "Earthwork."

### 3.8 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
  - 1. Arrange with utility companies to shut off indicated utilities.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Architect's written permission.

### **3.9 CLEARING AND GRUBBING**

- A. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
- B. Place fill material in horizontal layers not exceeding a loose depth of eight inches, and compact each layer to a density equal to adjacent original ground.

### **3.10 TOPSOIL STRIPPING**

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

### **3.11 EXPLOSIVE DEMOLITION**

- A. Explosives: Use of explosives is not permitted.

### **3.12 SITE RESTORATION**

- A. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Division 31 Section "Earthwork."
- B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

### **3.13 SITE IMPROVEMENTS**

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

### **3.14 DISPOSAL**

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

### **3.15 REPAIRS**

- A. General: Promptly repair damage to adjacent construction caused by building demolition operations.
- B. Where repairs to existing surfaces are required, patch to restore surface to original or better condition.
- C. Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

### **3.16 RECYCLING DEMOLISHED MATERIALS**

- A. General: Separate recyclable demolished materials from other demolished materials to the maximum extent possible. Separate recyclable materials by type.
  - 1. Provide containers or other storage method approved by Architect for controlling recyclable materials until they are removed from Project site.
  - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 3. Stockpile materials away from demolition area. Do not store within drip line of remaining trees.
  - 4. Store components off the ground and protect from the weather.
  - 5. Transport recyclable materials off Owner's property and legally dispose of them.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling building demolition materials shall accrue to Owner.

### **3.17 DISPOSAL OF DEMOLISHED MATERIALS**

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

### **3.18 CLEANING**

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

**KPFF**  
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January 10, 2022  
DSA BACK CHECK

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

**END OF SECTION 02 41 16**

## SECTION 03 30 00 – CAST-IN-PLACE CONCRETE

### 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. Latest edition of American Concrete Institute, ACI 318 and Manual of Concrete Practice (inclusive of all Parts).
- C. If conflict occurs between the Contract Drawings, the Project Manual, ACI 318, and the Manual of Concrete Practice, the most stringent takes precedence.

#### 1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

#### 1.3 DEFINITIONS

- A. Architectural Concrete: Concrete that is exposed as an interior or exterior surface in the completed structure and is designated as architectural concrete in the Contract Documents; contributes to visual character of the completed structure and therefore requires special care in the selection of the concrete materials, forming, placing and finishing to obtain the desired architectural appearance. Grout clean finish-Otherwise known as sack and patch for the architectural concrete.
- B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
- C. Strength Test: The average of the strengths of at least two 6 by 12 inch cylinders or at least three 4 by 8 inch cylinders made from the same sample of concrete and tested at 28 days or at test age designated for determination of specified compressive strength of concrete.

#### 1.4 ACTION SUBMITTALS

- A. **Product Data**: For each product indicated.



- B. **Design Mixtures:** For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
1. Indicate amounts of mixing water to be withheld for later addition at Project site.
  2. Include qualified strength test records if design mixture is based on field experience.
  3. Include results of trial mixtures if design mixture is based on trial mixtures.
  4. Include results of modulus of elasticity tests on trial mixtures.
  5. Design mixture to be signed and sealed by a professional Civil or Structural Engineer licensed in the State in which the Project is constructed.
- C. **Steel Reinforcement Shop Drawings:** Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installers.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
  2. Admixtures.
  3. Form materials and form-release agents.
  4. Steel reinforcement and accessories.
  5. Curing compounds.
  6. Floor and slab treatments.
  7. Vapor retarders, including subbase materials.
  8. Bonding agents.
  9. Repair materials.
  10. Semirigid joint filler.
  11. Joint-filler strips.

- D. Material Test Reports: For the following, from a qualified Testing Agency, indicating compliance with requirements:
  - 1. Aggregates.
- E. ICC ES Evaluation Reports: For evidence of Building Code compliance:
  - 1. Mechanical splices and connectors for reinforcing steel.
  - 2. Slab punching shear resisting system.
- F. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
- G. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
  - 1. Location of construction joints is subject to approval of the Architect.
- H. Minutes of preinstallation conference.

## **1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
  - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel.
- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
  2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- F. Concrete Testing Service: Engage a qualified independent Testing Agency to perform material evaluation tests and to design concrete mixtures.
- G. Preinstallation Conference: Conduct conference at Project site.
1. Review special inspection and Testing Agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection

## 1.7 DELIVERY, STORAGE, AND HANDLING

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

## PART 2 - PRODUCTS

### 2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
1. Plywood, metal, or other approved panel materials.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- E. Void Forms: Structurally sufficient to support weight of plastic concrete and other superimposed loads.
1. Expanded polystyrene (EPS); ASTM C578, Type XI.

- F. Chamfer Strips: Wood, metal, PVC, or rubber strips.
- G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- H. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.

## **2.2 STEEL REINFORCEMENT**

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

## **2.3 REINFORCEMENT ACCESSORIES**

- A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Dowel Bar Sleeves: Circular PVC sleeve, sealed one end, dowel bar embedment plus 1 inch in length, and 1/16 inch annular space inside diameter.
- C. Deformed Bar Anchors: ASTM A1064/A1064M, deformed steel wire; AWS D1.1/D1.1M, Type C.
- D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
  - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
- E. Mechanical Splices and Connectors: Comply with ACI 318 and ACI 439.3R, Type I and Type II.
  - 1. Furnish splicing and connector system with current ICC ES Evaluation Report.
- F. Punching Shear Reinforcing for Slabs: Comply with ACI 318 and ACI 421.1R.

1. Furnish shear reinforcing system with current ICC ES Evaluation Report.

## 2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project.
  1. Portland Cement: ASTM C150/C150M, Type I or Type II. Supplement with the following:
    - a. Fly Ash: ASTM C618, Class F.
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source.
  1. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm) nominal, unless noted otherwise on drawings.
  2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Lightweight Aggregate: ASTM C330/C330M, expanded shale, presize before firing, 3/4-inch nominal maximum aggregate size.
- D. Water: ASTM C 94/C 94M.

## 2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C260/C260M .
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  1. Retain one or more chemical admixtures from six subparagraphs below.
  2. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  3. Retarding Admixture: ASTM C494/C494M, Type B.
  4. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
  5. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
  6. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.

## **2.6 FLOOR AND SLAB TREATMENTS**

- A. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.
- B. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.

## **2.7 LIQUID FLOOR TREATMENTS**

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

## **2.8 CURING MATERIAL**

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.

## **2.9 RELATED MATERIALS**

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D2240.
- C. Reglets: Fabricate reglets in concrete to receive flashing from other trades of not less than 0.022-inch thick galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- D. Dovetail Anchor Slots: Provide as shown on Drawings. Hot-dip galvanized-steel sheet, not less than 0.034-inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

## 2.10 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C150/C150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
  2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
  4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C150/C150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
  2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
  3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
  4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C109/C109M.
- C. Epoxy Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

## 2.11 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified independent Testing Agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

- B. Modulus of Elasticity: Modulus of elasticity tests (ASTM C469/C469M) shall be performed on laboratory trial mixtures for each concrete strength, each concrete mix design and for each aggregate source. Modulus of elasticity to be tested using servo controlled electromechanical United machines or servo controlled hydraulic Satec machines. Maintain rate of loading to  $35 \pm 4$  psi in lieu of that specified in ASTM C469/C469M.
1. The modulus of elasticity (psi) at 28 days shall be a minimum of 100% of the target modulus of elasticity. Additional modulus of elasticity tests shall be performed on laboratory trial mixtures as follows:
    - a. Concrete for Mild-Reinforced Slabs: The modulus of elasticity at 7 days or at time of formwork stripping, whichever comes first, shall be a minimum of 90% of the target modulus of elasticity.
    - b. Concrete for Post-Tensioned Slabs: The modulus of elasticity at 3 days or at time of tendon stressing, whichever comes first, shall be a minimum of 85% of the target modulus of elasticity.
  2. Use a qualified independent Testing Agency for preparing and reporting results of modulus of elasticity tests.
- C. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash: 25 percent maximum
    - a. Fly ash is not permitted in suspended slabs.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
- E. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing admixture in concrete, as required, for placement and workability.
  2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  3. Use water-reducing admixture in pumped concrete, concrete for parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

## 2.12 FABRICATING REINFORCEMENT

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



## 2.13 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94/C94M, and furnish batch ticket information.
  - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

## PART 3 - EXECUTION

### 3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117, unless specified otherwise in the Contract Documents.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
  - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
  - 2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  - 1. Install keyways, reglets, recesses, and the like, for easy removal.
  - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete, unless otherwise indicated on Drawings.

- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### **3.2 EMBEDDED ITEMS**

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

### **3.3 REMOVING AND REUSING FORMS**

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 12 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
  - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength.
  - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### 3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
  - 1. Weld reinforcing bars according to AWS D1.4/D1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

### 3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
  - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
  - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  - 5. If not indicated, space vertical joints in walls at 25 feet intervals and 15 feet from corners. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
    - a. Perform saw-cutting before concrete starts to cool, as soon as the concrete surface is firm enough not to be torn or damaged by the blade, and before random drying-shrinkage cracks can form in the concrete slab. Joints produced by conventional dry- or wet-cut process shall be made within 4 hours in hot weather and within 12 hours in cold weather after the slab has been finished.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
  2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint or use PVC dowel bar sleeve.

### 3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Retain subparagraph below if high-range water-reducing admixtures are permitted.
  2. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of

weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
  2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
  3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  2. Maintain reinforcement in position on chairs during concrete placement.
  3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  4. Deviation from cross sectional thickness of suspended slabs shall not exceed  $\pm 1/4"$ .
  5. Deviation from elevation of suspended slabs before removal of supporting shores shall not exceed  $+3/8"$  nor  $-1/4"$ .
  6. Slope surfaces uniformly to drains where required.
  7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- E. Cold-Weather Placement: Comply with ACI 306R and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

- F. Hot-Weather Placement: Comply with ACI 301 and 305R and as follows:
1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

### 3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces exposed to view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### 3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
  1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, or built-up or membrane roofing.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
  1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
  2. Finish surfaces to the following tolerances, according to ASTM E1155, for a randomly trafficked floor surface:
    - a. Specified overall values (SOV) of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values (MLV) of flatness, F(F) 17; and of levelness, F(L) 15.
    - b. Specified overall values (SOV) of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values (MLV) of flatness, F(F) 24; and of levelness, F(L) 17; for surfaces to receive thin-set flooring.
  3. For floor installations 10,000 sq. ft. or less in total project area, finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft. long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch (90 percent compliance) in accordance to ACI 117 Section 4.8.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
  1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
  1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive aluminum granule finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:

**ADDENDUM 3 - RFI 61**

61. Q: Per section 033000-16, paragraph 3.8, D, 2b, please indicate where floor finish F35 and FL25 apply.

1. Uniformly spread 25 lbs./100 sq. ft. of dampened slip-resistive aluminum granules over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
  2. After broadcasting and tamping, apply float finish.
  3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aluminum granules.
- H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:
1. Uniformly apply dry-shake floor hardener at a rate of 100 lbs./100 sq. ft. unless greater amount is recommended by manufacturer.
  2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
  3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

### 3.9 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

### 3.10 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306R for cold-weather protection and ACI 305R for hot-weather protection during curing.



- B. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
  - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
    - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

### 3.11 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
  - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
  - 2. Do not apply liquid to concrete sooner than that recommended by manufacturer.
  - 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.

### 3.12 JOINT FILLING

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

### 3.13 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
  - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
  3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
  4. Repair technique shall be tested on a mockup or surface to be concealed later, before repairing surfaces exposed to view, for approval by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  2. After concrete has cured at least 14 days, correct high areas by grinding.
  3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
  5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place

patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

### 3.14 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified Testing Agency to perform field tests and inspections and prepare test reports.
- B. Inspections: Verify and inspect concrete Work as shown on Drawings.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:
  - 1. Testing Frequency: Obtain at least one random composite sample for each 150 cu. yd. of concrete or 5,000 sq. ft. of surface area of slabs of walls, or fraction thereof, of each concrete mixture placed each day.
    - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  - 2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
  - 3. Air Content: ASTM C231/C231M, pressure method, for normal-weight concrete; ASTM C173/C173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  - 4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
  - 5. Unit Weight: ASTM C567/C567M, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  - 6. Compression Test Specimens: ASTM C31/C31M.
    - a. Mild-Reinforced and Post-Tensioned Slabs and Beams: Cast and laboratory-cure four standard cylinder plus one spare standard cylinder specimens for each composite sample.

- 1) Cast and field-cure additional standard cylinder specimens to verify concrete strength for removal of shoring and reshoring in multistory construction. Number of field-cured cylinder specimens to be determined by Contractor.
- 2) Cast and field-cure additional standard cylinder specimens to verify concrete strength for stressing of tendons in post-tensioned construction. Number of field-cured cylinder specimens to be determined by Contractor.
- b. Shear Walls and Columns: Cast and laboratory-cure five standard cylinder plus one spare standard cylinder specimens for each composite sample.
- c. Other Concrete Elements: Cast and laboratory-cure four standard cylinder plus one spare standard cylinder specimens for each composite sample.
7. Field-cured specimens in first subparagraph below may be required to verify adequacy of curing and protection of concrete, to verify strength for tilt-up concrete and post-tensioning concrete, or to verify strength for removal of shoring and reshoring in multistory construction. Revise number of test specimens if required.
  - a. Mild-Reinforced Concrete Slabs: Test one laboratory-cured specimen at 4 days and one laboratory-cured specimen at 7 days or upon formwork stripping, whichever comes first; and two laboratory-cured specimens at 28 days.
  - b. Post-Tensioned Concrete: Test one laboratory-cured specimen at age determined by contractor, and one laboratory-cured specimen at 7 days; and two laboratory-cured specimens at 28 days.
  - c. Shear Walls and Columns: Test one laboratory-cured specimen at 7 days, one laboratory-cured specimen at 56 days and one laboratory-cured specimen at 90 days; and two laboratory-cured specimens at 28 days.
  - d. Other Concrete Elements: Test two laboratory-cured specimens at 7 days and two laboratory-cured specimens at 28 days.
  - e. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite and tested at the age indicated.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
  - a. If 28-day compressive-strength test falls below satisfactory levels, strength test the spare cylinder at age determined by the Contractor and average with the strength of the 28-day specimens. The average strength of the three cylinders shall be considered one compressive-strength test.
9. Modulus of Elasticity Test Specimens: ASTM C31/C31M.

- a. Mild-Reinforced and Post-Tensioned Slabs and Beams: Cast and field-cure ten standard cylinder specimens plus two spares for each composite sample.
    - 1) Composite samples (consisting of 12 standard field-cured cylinder specimens) for each concrete strength, each concrete mix design and for each aggregate source, shall be randomly selected from every five floors, with two random composite samples minimum per building.
  - b. Shear walls and columns: Cast and field-cure eight two standard cylinder specimens plus two spares for each composite sample.
    - 1) Composite samples (consisting of 10 standard field-cured cylinder specimens) for each concrete strength, each concrete mix design and for each aggregate source, shall be randomly selected from every five floors, with two random composite samples minimum per building.
10. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing.
- a. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete Testing Agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for each age tested.
  - b. Reports of modulus of elasticity tests shall contain Project identification name and number, mix identification number, specimen identification number, curing and environmental history of specimen, date of test, name of Testing Agency, and plot of the results with age of concrete as the abscissa and modulus of elasticity as the ordinate..
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- D. Measure floor and slab flatness and levelness according to ASTM E1155 within 24 hours of finishing.

**3.15 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 03 30 00**

## SECTION 03 30 05 – SITE CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Related Sections:
  - 1. Section 32 13 13 “Concrete Paving” for surface finish.

#### 1.2 ACTION SUBMITTALS

- A. **Product Data:** For each type of product indicated.
- B. **LEED Submittals:**
  - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
  - 2. Product Data for Credit IEQ 4.3: For curing and sealing compounds, documentation including printed statement of VOC content.
  - 3. Design Mixtures for Credit ID 1.1: For each concrete mixture containing fly ash as a replacement for Portland cement or other Portland cement replacements, and for equivalent concrete mixtures that do not contain Portland cement replacements.
- C. **Design Mixtures:** For each concrete mixture.
- D. **Steel Reinforcement Shop Drawings:** Placing drawings that detail fabrication, bending, and placement.
- E. **Samples:** Provide a 3’ tall x 3’ long x 8” wide job site sample of each site wall finish specified, for review and approval by District’s Representative prior to installation. Sample shall represent final appearance of the site wall, including construction joints and any stain, sealer or other surface applications. Provide additional samples until finish is considered acceptable by the District’s Representative, at no additional cost to the Owner. The approved sample shall serve as a standard of appearance for the final work to be produced and shall remain on site until all site walls have been reviewed and approved by the District’s Representative.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly and support of formwork.
- B. Material certificates.
- C. Material test reports.



## 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
  - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

## PART 2 - PRODUCTS

### 2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

### 2.2 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
- B. Reinforcing Bars: ASTM A 615/A 615M, deformed.
  - 1. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class I zinc coated after fabrication and bending.
  - 2. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.
- D. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- E. Galvanized-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from galvanized-steel wire into flat sheets.
- F. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A coated, Type 1, deformed steel.
- G. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

## 2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  - 1. Portland Cement: ASTM C 150, gray.
  - 2. Blended Hydraulic Cement: ASTM C 595, cement.
- B. Normal-Weight Aggregates: ASTM C 33, graded.
  - 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Lightweight Aggregate: ASTM C 330, 1/2 inch nominal maximum aggregate size.
- D. Water: ASTM C 94/C 94M and potable.

## 2.4 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

## 2.5 FIBER REINFORCEMENT

- A. Synthetic Micro-Fiber: Fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches long.

## 2.6 WATERSTOPS

- A. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
- B. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops, for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals. Factory fabricate corners, intersections, and directional changes.
- C. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

- D. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
- E. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

## 2.7 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
- B. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 millimeters thick.

## 2.8 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz. /sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating.
- G. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
  - 1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
  - 1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.9 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

## 2.10 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, by not less than 40 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing admixture in concrete, as required, for placement and workability.
  - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  - 3. Use water-reducing admixture in pumped concrete, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
- D. Proportion normal-weight concrete mixture as follows:
  - 1. Minimum Compressive Strength: 3000 psi at 28 days, unless otherwise indicated on the contract drawings.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.50.
  - 3. Slump Limit: 4 inches, plus or minus 1 inch.
  - 4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
  - 5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
  - 6. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
  - 7. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 pound /cubic yards.
- E. Proportion structural lightweight concrete mixture as follows:
  - 1. Minimum Compressive Strength: 5000 psi at 28 days, unless otherwise indicated on the contract drawings.
  - 2. Calculated Equilibrium Unit Weight: 115 lb. /cubic feet, plus or minus 3 pound /cubic feet, as determined by ASTM C 567.
  - 3. Slump Limit: 4 inches, plus or minus 1 inch.
  - 4. Air Content: 6 percent, plus or minus 2 percent at point of delivery for nominal maximum aggregate size greater than 3/8 inch.
  - 5. Air Content: 7 percent, plus or minus 2 percent at point of delivery for nominal maximum aggregate size 3/8 inch or less.
  - 6. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
  - 7. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 pound /cubic yard.

## 2.11 FABRICATING REINFORCEMENT

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

## **2.12 CONCRETE MIXING**

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

## **2.13 ACCESSORIES**

- A. Pre-emergent Herbicide: Surflan.
- B. Integral Color (Non-immersion Conditions: L.M. Scofield Chromix or approved equal.
- C. Chemical Surface Retarder: 'Top-Cast' by Grace Construction Products.
- D. Liquid Surface Sealer: 'HLQ-125 by Sinak Corporation.
- E. Patch Bond: Weld-Crete.

## **PART 3 - EXECUTION**

### **3.1 FORMWORK**

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Chamfer or radius exterior corners and edges of permanently exposed concrete.

### **3.2 EMBEDDED ITEMS**

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

### **3.3 VAPOR RETARDERS**

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
  - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.

### **3.4 STEEL REINFORCEMENT**

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

### 3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Waterstops: Install in construction joints and at other joints indicated according to manufacturer's written instructions.

### 3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- C. Cold-Weather Placement: Comply with ACI 306.1.
- D. Hot-Weather Placement: Comply with ACI 301.

### 3.7 CONCRETE FINISHING

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
  1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform

- color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
  3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part Portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Related Unformed Surfaces: At tops of walls, steps, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.
- E. See plan for finishes and finish locations.

### 3.8 CONCRETE PROTECTION, CURING AND SEALING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 pound/square foot x height before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Concrete surface sealer: All concrete paving shall be sealed with a clear penetrating concrete sealer. If efflorescence or alkali-staining is evident after the concrete has cured, lightly wash the surface with a mild muriatic acid solution (usually a 10:1 dilution) that has been thoroughly rinsed with water and cleaned with diluted Lithochrome Floor Cleaner by L.M. Scofield, or approved equal. Rinse again and dry thoroughly. After concrete mix has cured for at least one month, the concrete surface shall be thoroughly washed with fresh, clean water. After surface is thoroughly dried, apply 'HLQ-125' as manufactured by SINAK Corporation, or approved equal, per manufacturer's specifications.

### 3.9 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

**3.10 FIELD QUALITY CONTROL**

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

**END OF SECTION 03 30 00**



## SECTION 03 54 16 - HYDRAULIC CEMENT UNDERLAYMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes hydraulic-cement-based, polymer-modified, self-leveling underlayment for application below interior floor coverings.

#### 1.2 COORDINATION

- A. Coordinate application of underlayment with requirements of floor-covering products and adhesives, to ensure compatibility of products.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: Signed by manufacturers of underlayment and floor-covering systems certifying that products are compatible.
- C. Field Test Results: Floor surface flatness and levelness measurements to determine compliance with specified tolerances.
- D. Preconstruction Test Reports: Prior to the installation of the underlayment, provide test results indicating slab moisture vapor emission meets the requirements of the finish flooring manufacturer in accordance with ASTM F 2170.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Installer who is approved by manufacturer and factory trained for application of underlayment products required for this Project.
- B. Product Compatibility: Manufacturers of underlayment and floor-covering systems certify in writing that products are compatible.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

## 1.7 FIELD CONDITIONS

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

### ADDENDUM 3 - RFI 62

62. Q: Per section 035416, is hydraulic cement underlayment required if cast in place concrete meets flatness and levelness specified?

A: Underlayment not required if cast in place concrete slab complies with specified floor flatness and levelness requirements.

## PART 2 - PRODUCTS

### 2.1 HYDRAULIC-CEMENT-BASED UNDERLAYMENTS

- A. Hydraulic Cement Underlayment: Hydraulic-cement-based, polymer-modified, self-leveling product that can be applied in minimum uniform thickness of 1/4 inch and that can be feathered at edges to match adjacent floor elevations.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ARDEX GmbH; K-15 Self-Leveling Underlayment Concrete.
    - b. BASF, Master Builders Solutions; MasterTop 111SL.
    - c. L&M Construction Chemicals, Inc.; Levelex.
    - d. MAPEI Corporation; Ultraplan 1 Plus.
  - 2. Cement Binder: ASTM C 150, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.
  - 3. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch; or coarse sand as recommended by underlayment manufacturer.
  - 1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.
- C. Water: Potable and at a temperature of not more than 70 deg F.
- D. Surface Sealer: Designed to reduce porosity as recommended by manufacturer for type of floor covering to be applied to underlayment.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

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

### **3.2 PREPARATION**

- A. General: Prepare and clean substrate according to manufacturer's written instructions.
- B. Provide clean, dry, neutral-pH substrate for underlayment application.
  - 1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
  - 2. Fill substrate voids to prevent underlayment from leaking.
- C. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond. Do not use solvents.
  - 1. Moisture Testing: Perform tests recommended by flooring manufacturer, but not less stringent than one of the following:
    - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.
  - 2. Alkalinity and Adhesion Testing: Perform tests recommended by flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
- D. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

### **3.3 APPLICATION**

- A. General: Mix and apply underlayment components according to manufacturer's written instructions.

1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
  2. Coordinate application of components to provide optimum adhesion to substrate and between coats.
  3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply underlayment to produce uniform, level surface.
1. Apply a final layer without aggregate to product surface.
  2. Feather edges to match adjacent floor elevations.
- D. Use the straightedge method test, ACI 117 to verify that there is no more than 1/4 inch deviation in flatness in a 10 foot span.
1. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface with carpeting:
    - a. Specified Overall Values (SOV):
      - 1) Flatness:  $F_F 25$ .
      - 2) Levelness:  $FL 20$ .
    - b. Minimum Local Values (MLV):
      - 1) Flatness:  $F_F 17$ .
      - 2) Levelness:  $FL 15$ .
  2. Apply a final layer without aggregate to product surface.
  3. Feather edges to match adjacent floor elevations.
- E. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.
- F. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.
- G. Apply surface sealer at rate recommended by manufacturer.
- H. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

### **3.4 FIELD QUALITY CONTROL**

- A. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

**3.5 PROTECTION**

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

**END OF SECTION**

## SECTION 04 26 13 - MASONRY VENEER

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar materials.
3. Ties and anchors.
4. Embedded flashing.
5. Accessories.
6. Mortar mixes.

B. Products Installed but not Furnished under This Section:

1. Steel lintels in masonry veneer.
2. Steel shelf angles for supporting masonry veneer.

C. Related Requirements:

1. Section 09 96 23 "Graffiti-Resistant Coatings" for graffiti-resistant coatings applied to masonry veneer assemblies.

#### 1.2 ACTION SUBMITTALS

A. **Product Data:** For each type of product.

B. **Shop Drawings:** For the following:

1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

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

1. Decorative CMUs.
2. Pigmented colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.

### 1.3 INFORMATIONAL SUBMITTALS

- A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- B. Material Certificates: For each type and size of the following:
1. Masonry units.
    - a. Include material test reports substantiating compliance with requirements.
  2. Integral water repellent used in decorative CMUs.
  3. Cementitious materials. Include name of manufacturer, brand name, and type.
  4. Mortar admixtures.
  5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
  6. Anchors, ties, and metal accessories.
- C. Qualification Statements: For testing agency.
- D. Mix Designs:** For each type of mortar. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
- E. Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

### 1.4 MOCKUPS

- A. **Wall Mockups:** Build mockups to set quality standards for materials and execution and to set quality standards for installation.
1. Build mockup as indicated on Drawings.
  2. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
  3. Protect accepted mockups from the elements with weather-resistant membrane.
  4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## **1.5 FIELD CONDITIONS**

- A. Protection of Masonry: During construction, cover tops of veneer, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  1. Extend cover a minimum of 24 inches down face of veneer, and hold cover securely in place.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry. Immediately remove grout, mortar, and soil that come in contact with masonry.
  1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  2. Protect sills, ledges, and projections from mortar droppings.
  3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- C. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

## **PART 2 - PRODUCTS**

### **2.1 SOURCE LIMITATIONS**

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

### **2.2 UNIT MASONRY, GENERAL**

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work and will be within 20 ft. vertically and horizontally of a walking surface.



## 2.3 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
- B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.
1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested in accordance with ASTM E514/E514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, will show no visible water or leaks on the back of test specimen.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) ACM Chemistries.
      - 2) BASF Corporation.
      - 3) Euclid Chemical Company (The); an RPM company.
      - 4) GCP Applied Technologies Inc.
      - 5) Moxie International.
- C. Decorative CMUs: ASTM C90, normal weight.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Products manufactured by Orco Block, as scheduled on Drawings.
  2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
  3. Pattern and Texture: As scheduled on Drawings.
  4. Colors: As indicated by manufacturer's designations.

## 2.4 MORTAR MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.
- B. Hydrated Lime: ASTM C207, Type S.

- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Mortar Cement: ASTM C1329/C1329M.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Lafarge North America Inc.
- E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Davis Colors.
    - b. Euclid Chemical Company (The); an RPM company.
    - c. Lanxess Corporation.
    - d. Solomon Colors, Inc.
    - e. Stone Creek Products.
- F. Colored Cement Products: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.
  - 1. Colored Portland Cement-Lime Mix:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Argos USA LLC.
      - 2) Holcim (US) Inc.
      - 3) Lehigh Hanson; HeidelbergCement Group.
    - 2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
    - 3. Pigments shall not exceed 10 percent of portland cement by weight.
    - 4. Pigments shall not exceed 5 percent of mortar cement by weight.
- G. Aggregate for Mortar: ASTM C144.
  - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  - 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
  - 3. White-Mortar Aggregates: Natural white sand or crushed white stone.

- H. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ACM Chemistries.
    - b. BASF Corporation.
    - c. Euclid Chemical Company (The); an RPM company.
    - d. GCP Applied Technologies Inc.
- I. Water: Potable.

## 2.5 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.
  2. Stainless Steel Wire: ASTM A580/A580M, Type 316.
  3. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 zinc coating.
  4. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
  5. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 316.
- B. Adjustable Masonry-Veneer Anchors:
1. General: Provide anchors that allow vertical adjustment but resist a 200 lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
  2. Fabricate sheet metal anchor sections and other sheet metal parts from steel sheet of thicknesses indicated, galvanized after fabrication.
  3. Fabricate wire ties from 3/16-inch **3/16-inch** diameter, hot-dip galvanized steel wire unless otherwise indicated.
  4. Masonry-Veneer Anchors; Adjustable veneer anchor with thermal break.
    - a. Basis of Design Product: Subject to compliance with requirements, provide **Hohmann & Barnard Thermal 2-Seal Wing Nut Anchor**, or comparable product by one of the following:
      - 1) Halfen.
      - 2) Wire-Bond.

5. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours in accordance with ASTM B117.

## 2.6 EMBEDDED FLASHING

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
  1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 316, 0.016 inch thick.
  2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 ft.. Provide splice plates at joints of formed, smooth metal flashing.
  3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Cheney Flashing Company.
      - 2) Hohmann & Barnard, Inc.
      - 3) Keystone Flashing Company, Inc.
  4. Fabricate through-wall flashing with drip edge where indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
  5. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
  6. Solder metal items at corners.
- B. Solder and Sealants for Sheet Metal Flashings: As specified in Section 07 62 00 "Sheet Metal Flashing and Trim."
  1. Solder for Stainless Steel: ASTM B32, Grade Sn60 Grade Sn96, with acid flux of type recommended by stainless steel sheet manufacturer.
- C. 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.

## 2.7 ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.
- B. Weep/Vent Products: Use the following unless otherwise indicated:

1. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch OD by 4 inches long.
- C. Proprietary Acidic Masonry Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Diedrich Technologies, Inc.; a Hohmann & Barnard company.
    - b. EaCo Chem, Inc.
    - c. PROSOCO, Inc.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 TOLERANCES**

- A. Dimensions and Locations of Elements:
  1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
  2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
  3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
- B. Lines and Levels:
  1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
  2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
  3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.

4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

### 3.3 ANCHORED MASONRY VENEERS

- A. Anchor masonry veneers to wall framing with seismic masonry-veneer anchors to comply with the following requirements:
1. Fasten seismic anchors through sheathing to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
  2. Embed tie sections in masonry joints.
  3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
  4. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
  5. Space anchors as indicated, but not more than 16 inches o.c. vertically and 25 inches o.c. horizontally, with not less than one anchor for each 3.5 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.
  6. Space anchors as indicated, but not more than 18 inches o.c. vertically and horizontally. Install additional anchors within 12 inches of openings and at intervals, not exceeding 24 inches, around perimeter.
- B. Provide not less than **1 inch** of airspace between back of masonry veneer and face of insulation.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

**END OF SECTION**

## SECTION 05 12 00 – STRUCTURAL STEEL

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Supply and install structural steel as indicated.

#### 1.2 RELATED SECTIONS

#### 1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 00: Submittal Procedures.
  - 1. **Materials Identification Report:** A report of material identification, together with identified copies of the mill test reports, shall be submitted to the District, Architect, District Inspector and Structural Engineer by the Testing Laboratory when manufacturer's mill test reports are used to establish conformity with material specifications.
  - 2. **Shop and Erection Drawings:** Submit checked prints of shop and erection drawings for structural steel work.
    - a. Shop drawings shall clearly indicate grade of steel, bolts, slip-critical surfaces, etc.
  - 3. Record Set of Drawings: After structural steel has been erected and approved shop and erection drawings have been corrected to correspond with changes made in field, submit a complete corrected set of prints.
  - 4. **Submit Welding Procedure Specification (WPS)** for each combination of weld variables, in accordance with AWS D1.1 requirements. For welds that are not prequalified, submit Procedure Qualification Record (PQR) and all supporting test data.
    - a. Submit weld filler material certificate of compliance and manufacturer data for review with the WPS.

#### 1.4 QUALITY ASSURANCE

- A. Structural steel shall conform to Title 24 California Code of Regulation, except that steel manufactured by acid Bessemer process shall not be used for structural purposes.
- B. Structural steel used in welded construction shall have the properties suitable for welding.
- C. Structural steel shall conform to "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings".



## **1.5 PRODUCT HANDLING**

- A. Store structural steel above ground on platforms, skids or other approved supports.
- B. Protect steel from corrosion.
- C. Store welding electrodes in accordance with AWS D 12.1.
- D. Store other materials in a weather tight and dry place, until ready for incorporation into work.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Stock Materials: Provide exact materials, sections, shapes, thicknesses, sizes, weights and details of construction indicated on Drawings. Changes because of material stock or shop practices will be considered for approval if net area of shape or section is not reduced thereby, if material and structural properties at least equivalent, and if overall dimensions are not exceeded.

### **2.2 MATERIALS**

- A. Structural Steel: All structural wide flange steel columns and beams shall conform to ASTM A992, Grade 50. All other channels, angles and miscellaneous plates shall conform to ASTM A36 unless noted otherwise.
- B. Steel Pipe: ASTM A53 - Type E or S, grade B.
- C. Structural Tubing:
  - 1. Hot-formed, ASTM A501.
  - 2. Cold-formed, ASTM A500, grade B.
- D. Bar Stock for Anchor Bolts: ASTM A36 or F1554 Gr 36/55 as noted on the Drawings
- E. Machine Bolts and Nuts: ASTM A307, grade A.
- F. High Strength Steel Bolts: ASTM A325
- G. Plain Washers: ANSI B27.2.
- H. Galvanizing: ASTM A123.
- I. Primer: "Tnemec 99" or approved equal.

## 2.3 FABRICATION

- A. Cleaning and Straightening Materials: All materials being fabricated shall be thoroughly cleaned of all scale and rust, and straightened before being worked on. Cleaning and straightening methods shall not injure material. After punching or working component parts of a member, all twists or bends shall be removed before parts are assembled.
- B. Fabricate work in accordance with 2019 CBC .
- C. Cutting, Punching, Drilling and Tapping: Unless otherwise indicated or specified, structural steel fabricator shall do all cutting, punching, drilling and tapping of his work so that work of other trades will properly connect to steel work.
- D. Milling: Compression joints depending on contact bearing shall have bearing surfaces prepared to a common plane by milling.
- E. Use of Burning Torch: Oxygen cutting of members shall be done by machine. Gouges greater than 3/16" that remain from cutting shall be removed by grinding. All reentrant corners shall be shaped notch free to a radius of at least 1/2". Gas cutting of holes for bolts or rivets is prohibited.
- F. Galvanizing: After fabrication, items indicated or specified to be galvanized shall be galvanized in largest practical sizes. "Fabrication" includes all operations of shearing, punching, bending, forming, assembling or welding. Galvanized items shall be free from projections, barbs or icicles resulting from galvanizing process.
- G. Welding:
  - 1. Type of steel used in welded structures shall have chemical properties suitable for welding as determined by chemical analysis. Welds shall conform to the requirements of Title 24.
  - 2. Materials and workmanship shall conform to the requirements specified herein and to 2019 CBC modified as follows:
    - a. No welded splices shall be made except those indicated on Drawings unless approved in writing by Structural Engineer.
    - b. Drawings will designate joints in which it is important that welding sequence and technique be controlled to minimize shrinkage stresses and distortion.
  - 3. Welding shall be performed in accordance with requirements of the "American Welding Society" (AWS) and "Structural Welding Code."
  - 4. Filler material for demand critical welds shall meet the requirements of AISC 341-10 section A4. Filler material for all other Seismic Load Resisting System (SLRS) shall meet the requirements of AISC 341-10 section 7.3a.
  - 5. Welding electrodes shall be E70xx unless noted otherwise on the Drawings.
- H. Shop Finish:

1. Notify the District Inspector when work is ready to receive shop prime coat. Work shall be inspected and approved by the District Inspector before application of primer.
2. Structural steel and fittings, except galvanized items, which will be exposed when building is completed shall receive a coat of primer.
3. The primer specified shall be spray applied, filling all joints and corners and covering all surfaces with a smooth unbroken film. The minimum dry film thickness of the primer shall be 2.0 mils. Follow manufacturer's instructions for thinning.

## **2.4 QUALITY CONTROL**

### **A. Tests:**

1. Structural steel shall be identified in accordance with CBC, the grade and ASTM specification number or designation shall be indicated on each lift or bundle of fabricated elements.
2. If structural steel cannot be identified at least one tension and elongation test and one bend flattening test shall be made for each piece.
3. For castings and forgings, chemical analysis and one tension and elongation test will be required for each heat. Complete four-sided inspection shall be made of all castings.
4. For sheet and strip steel, one tension and elongation test and one bend or flattening test for each 5 tons or fractional part thereof for each size or gage will be required.
5. Test specimens shall be furnished by steel fabricator and taken under direction of the Testing Laboratory to dimensions required by "Standard Methods and Definitions for Mechanical Testing of Steel Products", ASTM A370.
6. Cost of tests of stock will be borne by the District, except that if a test fails to comply with requirements of Specifications, cost of testing shall be borne by Contractor.
7. If after fabrication and inspection, work is found to be defective and requires re-inspection, costs of such re-inspection shall be borne by Contractor.
8. Steel fabricator shall provide all labor, equipment and facilities necessary for moving and handling materials to be inspected.

### **B. Welding Inspections:**

1. Inspection of all shop and field welding operations shall be made by a qualified Welding Inspector . The welding inspector shall make a systematic record of all welds including:
  - a. Identification marks of welders.
  - b. List of defective welds.

- c. Manner of correction of defects.
  2. The Welding Inspector shall be notified at least 2 days before shop or field welding inspection is to be required.
  3. The Welding Inspector shall check the material, equipment and procedures, as well as welds and competence of welder. He shall furnish a report that welding which is required to be inspected is proper and has been done in conformity with approved Drawings and Specifications.
  4. The Welding Inspector shall use all means necessary to determine quality of weld and may use gamma ray, magnaflux, trepanning sonics or any other aid to visual inspection deemed necessary to assure adequacy of welding.
  5. All complete joint penetration welds shall be subject to Ultrasonic Testing, as per AWS D1.1. All defective welds shall be repaired and retested with ultrasonic equipment at the Contractor's expense.
- C. Inspection of Shop Fabrication: Shall be in accordance with CBC.
- D. Inspection of High Strength Bolt Installation: Shall be in accordance with CBC.
- E. Tests of Headed Shear Studs: Headed shear studs shall be tested in accordance with CBC.

### **PART 3 - EXECUTION**

#### **3.1 VERIFICATION**

- A. Verify governing dimensions and conditions at job site before commencing erection work.

#### **3.2 ERECTION**

- A. Erect all steel in strict accordance with Drawings, approved shop drawings and all standards.
- B. Where indicated for field connections, standard bolts (ASTM A307), do not require washers under head or under nut, except that beveled washers are required when outer face of the bolted parts have a slope greater than 5%.
- C. Install high strength steel bolts at locations indicated. Assembly and installation shall be in accordance with 2019 CBC.
- D. Erect structural steel plumb and level and to proper tolerances as set forth in the AISC Manual. Provide all temporary bracing, supports or connections required for complete safety of structure until final permanent connections are made.

- E. Set column bases within a tolerance of 1/8" of detailed center lines, and set and level at proper elevations. Support bases on double nuts and solidly fill all spaces under bases with drypack cement grout rammed into place.

### **3.3 FINISHING**

- A. After erection, spots or surfaces where paint has been removed, damaged, or burned off and field rivets, bolts, and other field connections not concealed in work, shall be cleaned of dirt, oil, grease, and burned paint and given a spot coat of same primer used for shop priming.
- B. Damaged galvanized surfaces shall be coated with Galvalloy, Galvabar or approved equal. Heat damaged surface to approximately 600 degrees Fahrenheit. Rub alloy bar over heated surface. Paint is not acceptable.

END OF SECTION 05 12 00

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## SECTION 05 31 50 – METAL FLOOR AND ROOF DECK

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Steel roof deck with accessories.
2. Bent plate and sheet metal closures at decking edges and openings.
3. Holes through decking, with reinforcing.
4. Welded shear studs for floor deck.

B. Related Work Specified Elsewhere:

1. Hoisting of decking.
2. Structural steel framing and supports for steel decking.

#### 1.2 SUBMITTALS

- A. **Shop Drawings:** Submit fully detailing and dimensioning all steel decking including accessories, fastenings, welding, holes with reinforcing, flashings, and closures. Indicate welding according to AWS Standard Welding Symbols. Show dimensioned layouts for openings and reinforcing details.
- B. **Calculations and Data:** If steel decking of type differing from that indicated or specified is proposed, submit the manufacturer's calculations and supporting data showing that proposed decking conforms to requirements indicated and specified. Include the decking manufacturer's technical product data and copies of code approvals for proposed decking. Submit with shop drawings and obtain approval prior to fabrication and delivery of decking.

#### 1.3 QUALITY ASSURANCE

- A. Qualifications of Welders: Employ welding operators currently tested and certified in accordance with code.
- B. Requirements of Regulatory Agencies: Provide steel roof deck system that, with concrete fill (and sprayed fireproofing where indicated), meets UL and code requirements.
- C. Source Quality Control: Furnish the decking manufacturer's certified mill analyses and test reports covering all decking.

## PART 2 - PRODUCTS

### 2.1 DECKING MATERIALS

- A. Furnish metal roof decking having galvanized coating conforming to ASTM A525, Class G60. Decking shall be fabricated of steel conforming to ASTM A446, Grade A, minimum yield 33,000 psi., unless otherwise noted. Provide vented deck where indicated on drawings.
- B. Roof Decking: Type and manufacture noted on the drawings, lengths to span over at least 3 supports unless otherwise shown, each panel factory slotted or having rolled-in moisture venting provisions.
- C. Low-Emitting Materials: Paints and coatings 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. Decking Accessories: Provide indicated and required decking accessories including, without limitation, welding washers and welding anchors, closures, transitions, and filler strips, as required for complete installations. Provide bent plate closures, angles, channels, and attachments as required for openings through decking for ducts, shafts, piping, and other penetrations; where decking changes direction; and at decking perimeter; fabricated of 16 gage galvanized steel unless otherwise shown. Provide roof drain and overflow sumps of minimum 14 gage galvanized steel.
- E. Galvanizing Repair Paint: Zinc rich paint conforming to Mil Spec MIL-P-21035 (SHIPS).
- F. Welded Stud Shear Connectors: As specified in Section 05 06 50.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF DECKING: Verify dimensions and actual site conditions to ensure proper fit and installation.

- A. Placing: Place steel decking on supports with full bearings, end joints centered over supports, and adjust to correct final position before completing permanent attachments. Place units in straight alignment for the entire length of run of flutes with close registration of flutes and with maximum 1/8" gap between ends of units, minimum 2" bearing on the supports. Do not splice units except at supports. Conform to code approvals and approved submittals.
- B. Cutting and Fitting: Perform cutting and fitting at columns, perimeters, shafts, stairs, and other openings. Provide tight fitting closures at the open uncovered ends and edges of decking, and all miscellaneous supports required to carry the metal decking. Secure hole reinforcement to decking with fillet welds placed on both sides of reinforcing members. Place reinforcement



channels and angles across flutes and to project a distance beyond sides of openings equal to the maximum size of the opening unless otherwise shown. Perform field cutting and trimming square and neat, equal to factory cutting.

- C. **Welding:** Use materials and methods in accordance with recommendations of metal decking manufacturer and approved submittals. Conform to AWS D1.1 and to the patterns and weld types shown, finished welds free of sharp points or edges. Field coat all welds and abraded surfaces upon completion with repair material. Omit the field coating where welds or abrasions are covered by concrete fill or sprayed fireproofing.
- D. **Damaged Decking:** Remove and replace all metal decking with dents or other damage that adversely affects deck strength or subsequent materials, as directed.

### **3.2 CLEANING AND TOUCH-UP**

- A. Remove surplus materials. Clean and touch-up raw edges of decking cut for openings with anodic galvanizing repair paint. Leave decks ready to receive subsequent materials.

### **3.3 FIELD QUALITY CONTROL**

- A. Install all metal decking under continuous inspection, welding approved by Inspector before being covered (Contractor to retain and pay for the inspection and testing services). Conform welder qualifications and welding inspection to Code.
- B. Additional inspecting at Contractor's expense will be performed to determine compliance of corrected work with specified requirements.

END OF SECTION 05 31 50

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## SECTION 05 40 00 - COLD-FORMED METAL FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes cold-formed metal framing.
- B. The Owner will engage an independent testing and inspection agency to verify the adequacy of the Contractor's quality control; refer to Section 01 40 00 "Quality Requirements." Before concealing the cold-formed metal framing work obtain the required inspections of same from a representative of the Owner's independent testing and inspection agency.

#### 1.2 ACTION SUBMITTALS

- A. **Product Data:** Submit product data for each type of cold-formed metal framing product and accessory indicated.
- B. **Shop Drawings:** Submit shop drawings of cold formed metal framing work. Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining Work. Plans and elevations shall be submitted at not less than 1/8" = 1'-0" scale, details of sections and connections shall be shown at not less than 1-1/2" = 1'-0" scale.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Submit mill certificates signed by steel sheet producer or test reports from a qualified independent testing agency indicating steel sheet complies with requirements.
- B. Product Test Reports: Submit product test reports from a qualified testing agency indicating that each of the following complies with requirements, based on comprehensive testing of current products:
- C. Research/Evaluation Reports: Submit evidence of cold-formed metal framing's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed cold-formed metal framing on a minimum of three projects similar in material, design, and extent to that indicated for this Project in the last 10 years that have a record of successful in-service performance.

- B. Mill certificates signed by steel sheet producer indicating steel sheet complies with requirements, including uncoated steel thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and galvanized-coating thickness.
- C. Standards: Comply with the applicable provisions and recommendations of the following standards below, where standards conflict the more stringent shall apply:
  - 1. AISI Specifications: Comply with AISI S100 "North American Specification for the Design of Cold-Formed Steel Structural Members" and AISI S200 "North American Standard for Cold-Formed Steel Framing - General Provisions" for calculating structural characteristics of cold-formed metal framing:
  - 2. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3/D1.3M, "Structural Welding Code--Sheet Steel."

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from moisture, soiling, corrosion, deformation (bending, denting, and twisting), and other damage during delivery, storage, and handling. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General: Provide cold-formed metal framing meeting or exceeding the following performance requirements:
  - 1. Structural Properties:
    - a. Wind Loads: The cold-formed metal framing work, including veneer, shall be designed, fabricated and installed to withstand the maximum inward and outward wind pressures as indicated on Drawings.
    - b. Seismic Loads: As indicated on Drawings.
    - c. Deflection Limitations:
      - 1) Deflections: Base calculations for the following deflections upon the combination of maximum direct wind loads, building deflections, thermal stresses, and erection tolerances. The deflection of framing members in a direction normal to the plane of the wall when subjected to the full code required wind loads specified above shall not exceed the following:
        - a) Cement Plaster Assemblies: 1/600 of their clear span.
        - b) Metal Wall Panel Assemblies: 1/360 of their clear span.
  - d. Dead Loads:

- 1) Limit deflections of metal members spanning door openings to 1/300. The clearance between the member and an operable door shall be no less than 1/16 inch.
- B. Thermal Movements: Fabricate the cold formed metal framing work to accommodate for such expansion and contraction of component materials, and supporting elements, as will be caused by surface temperatures ranging from -5 to +180 deg F, without causing buckling, failure of joint sealants, sheathing failures, undue stress on metal members and fasteners, weld failures, failure of doors or other operating units to function properly, reduction of performance, and other detrimental effects.
1. Dimensions shown on Drawings are based on an assumed design temperature of +70 deg F. Fabrication and erection procedures shall take into account the ambient temperature range at the time of the respective operations.
- C. Building Frame Movement: Design, fabricate and install cold formed metal framing to withstand building movements including thermal movements, loading deflections, shrinkage, creep and similar movements. Thermal movements shall be as specified above. Building frame deflections, shrinkage, creep and other movements are available from the structural engineer.

## 2.2 MATERIALS

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
1. Grade: As required by structural performance.
  2. Coating: G90 or equivalent.
- B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
1. Grade: As required by structural performance.
  2. Coating: G90.

## 2.3 EXTERIOR WALL NON-LOAD-BEARING FRAMING MEMBERS

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, complying with ASTM C 955, and as follows:
1. Minimum Uncoated-Steel Thickness: Minimum 0.0538 inch unless greater thickness is required to suit performance criteria.
  2. Flange Width: 1-5/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened (straight) flanges, complying with ASTM C 955, and as follows:

1. Minimum Uncoated-Steel Thickness: Matching steel studs.
  2. Flange Width: 1-1/4 inches.
- C. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads, and as follows:
1. Minimum Uncoated-Steel Thickness: As required to suit performance requirements.
  2. Flange Width: Size to accommodate deflection of primary structure. Primary structure deflections are available from the structural engineer.
- D. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, **types as indicated on Drawings**, capable of accommodating upward and downward vertical displacement of primary structure. Primary structure deflections are available from the structural engineer.
- E. Rigid Connectors: Manufacturer's standard clips, **types as indicated on Drawings**, capable of accommodating anticipated loading to attach CFS components rigidly to each other or the primary structure.

## 2.4 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
1. Supplementary framing.
  2. Bracing, bridging, and solid blocking.
  3. Web stiffeners.
  4. End clips.
  5. Gusset plates.
  6. Stud kickers, knee braces, and girts.
  7. Hole reinforcing plates.
  8. Backer plates.

## 2.5 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123.
- B. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.

- C. Powder-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
  - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- E. Welding Electrodes: Comply with AWS standards.

## **2.6 MISCELLANEOUS MATERIALS**

- A. Galvanizing Repair Paint: High zinc dust content primer paint complying with SSPC-Paint 20, DOD-P-21035, or ASTM A 780/A 780M.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION, GENERAL**

- A. Provide the sizes, gage and spacing of cold-formed metal framing indicated and as required by the performance requirements. Install cold-formed metal framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated, unless more stringent requirements are indicated.
- B. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to manufacturer's written recommendations and requirements in this Section.
  - 1. Cut framing members by sawing or shearing; do not torch cut.
  - 2. Fasten cold-formed metal framing members by welding in accordance with the framing manufacturer's instructions and the structural design calculations. Wire tying of framing members is not permitted. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

3. Fasten cold-formed metal framing members by screw fastening. Wire tying of framing members is not permitted. Locate screws according to the structural design calculations and install in accordance with the screw manufacturer's printed instructions, with screw penetrating joined members by not less than three exposed screw threads.
- C. Install framing members in one-piece lengths. Splices in framing members will not be permitted.
- D. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- E. Install insulation specified in Section 07 21 00 "Thermal Insulation," in built-up exterior framing members that are inaccessible on completion of cold-formed framing work.
- F. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- G. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and spaced so as to permit the proper attachment of cladding systems.

### 3.3 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated. Provide fasteners at all corners and ends of tracks.
- B. Set studs plumb and fasten both flanges of studs to bottom track, unless otherwise indicated. Space studs 16 inches o.c. unless closer spacing is required by structural calculations. Provide studs at each side of openings, not more than 2 inches from abutting walls, and frame all inside and outside corners with three studs.
- C. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
  1. Install single deep-leg deflection tracks and anchor to building structure.
  2. Connect vertical deflection clips to bypassing and infill studs and anchor to primary building structure.
- D. Install horizontal bridging in wall studs, sized and spaced in rows indicated on Shop Drawings and calculations. Fasten at each stud intersection.
  1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track unless otherwise required by the shop drawings and calculations. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.



2. Install supplementary framing and connections, including studs, stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, for the attachment of subsequent cladding materials and as required to provide a complete and stable wall-framing system.

### **3.4 FIELD QUALITY CONTROL**

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

### **3.5 REPAIRS AND PROTECTION**

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.
- B. Provide protection and maintain conditions, in a manner acceptable to manufacturer and installer, that ensure cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

### **END OF SECTION**

## SECTION 05 50 00 - METAL FABRICATIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes metal fabrications and includes, but is not limited to, the following types of fabrications:
1. Supports for counter tops and vanities.
  2. Aluminum framed entrance and storefront framing.
  3. Curtain wall secondary support framing.
  4. Tube framing for partial height walls.
  5. Overhead coiling grille framing.
  6. Steel ladders.

#### 1.2 COORDINATION

- A. 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.

#### 1.3 ACTION SUBMITTALS

**A. CALgreen Submittals:**

1. Product Data for Section 5.504.4.1.1: Provide documentation for adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks, including printed statement of VOC content showing compliance with local or regional air pollution control or air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits as shown in CALgreen Tables 5.504.4.1 and 5.504.4.2.
2. Product Data for Section 5.504.4.1.2: Provide documentation for aerosol adhesives, and smaller unit sizes of adhesives, sealant, and caulking compounds (in units of product, less packaging, which do not weigh more than one (1) pound and do not consist of more than sixteen (16) fluid ounces) comply with statewide VOC standards and prohibitions on use of certain toxic compounds, of CCR Title 17, commencing with Section 94507.
3. Product Data for Section 5.504.4.3: For architectural paints and coatings, provide documentation including printed statement of VOC content showing compliance with Table 1 of the ARB, Architectural Coatings Suggested Control Measure, unless more stringent local limits apply.
4. Product Data for Section 5.504.4.3.1: Aerosol paints and coatings, provide documentation that products meet the PWMIR Limits for ROC in Section 94522 (a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Section 94522(c)(2 and (d)(2) of CCR Title 17.

- B. **Shop Drawings:** Submit shop drawings detailing the fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
1. For installed products indicated to comply with design loads, include structural analysis data, for information only, signed and sealed by the qualified professional engineer responsible for their preparation.
  2. Include plans and elevations at not less than 1" to 1'-0" scale, and include details of sections and connections at not less than 3" to 1'-0" scale.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding Certificates: Copies of certificates for welding procedures and personnel.

#### 1.5 QUALITY ASSURANCE

- A. Fabricator/Installer Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project for a minimum of 5 years, with a record of successful in-service performance, with sufficient production capacity to produce required units without causing delay in the work.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal fabrications that are similar to those indicated for this Project in material, design, and extent.
- C. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code--Steel."
  2. AWS D1.3/D1.3M, "Structural Welding Code--Sheet Steel."
  3. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store metal fabrications in a dry, well-ventilated, weathertight place. Deliver and handle so as to prevent any type of damage to the fabricated work.

#### 1.7 FIELD CONDITIONS

- A. Field Measurements: Where metal fabrications 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.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

#### A. Structural Performance:

1. Counter Tops and Vanities: Provide countertop and vanity framing capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections, or of exhibiting excessive deflections in any of the components making up the countertops and vanities:
  - a. All deadloads.
  - b. 500 pound live load placed on the countertop and vanity.
  - c. Deflection at Midspan:
    - 1) Stone or Quartz Simulated Stone:  $L/720$  times span or 1/8 inch, whichever is less.
    - 2) Solid Surfacing:  $L/360$  times span or 1/4 inch, whichever is less.
2. Tube Framing for Partial Height Walls: Provide tube framing for partial height walls capable of withstanding a deflection not to exceed  $L/720$  of the wall height when subjected to a positive and negative pressure of 5 psf.
3. Overhead Coiling Grilles,: Fabricate and install support framing capable of supporting all deadloads and withstanding live loads imposed from functioning operations.
4. Exterior Aluminum Framed Entrances and Storefront Framing,: Fabricate and install secondary support framing capable of supporting all deadloads and withstanding live loads imposed on it from the entrance and storefront primary framing with deflection limited to not more than  $1/360$  of component span.
5. Curtain Wall Secondary Support Framing: Fabricate and install secondary support framing capable of supporting all deadloads and withstanding live loads imposed on it from the curtain wall primary framing with deflection limited to not more than  $1/360$  of component span.
6. Other Overhead Anchored Fabrications: Fabricate and install framing as required to sustain imposed loads and to limit deflections to  $L/720$  between hangers.
7. Support Framing for decorative items: Provide framing for partial height items, full height items, floor to ceiling anchored items, and other items within 48 inches of the floor should be capable of withstanding a deflection not to exceed  $L/720$  of the height when subjected to a positive and negative pressure of 5 psf.

#### B. Exterior Metal Fabrications: All exterior metal fabrications shall be fabricated and installed to prevent buckling, opening up of joints and overstressing of welds and fasteners under the following temperature conditions:

1. Base fabrication on a temperature of +70 deg F at time of installation with allowance made for an exposed metal surface temperature range of -5 deg F to +180 deg F. Make all necessary adjustments and provisions for concealed expansion.

## 2.2 METALS, GENERAL

- A. Metal Surfaces, General: For metal fabrications 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.

## 2.3 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.
- C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- D. Cold Finished Steel Bars: ASTM A 108, grade as selected by fabricator.
- E. Rolled-Stainless-Steel Floor Plate: ASTM A 793.
- F. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) minimum, unless otherwise indicated or required to satisfy the performance requirements; finish as follows:
  - 1. Black finish, unless otherwise indicated.
  - 2. Galvanized finish for exterior installations and where indicated.
- G. Slotted Channel Framing: Cold-formed metal channels with continuous slot and with flanged edges returned toward web complying with MFMA-4 and fabricated from steel complying with ASTM A 1011/A 1011M. Width, depth, and metal thickness as required to suit performance requirements.
- H. Cast-in-Place Anchors in Concrete: Anchor channel type, with filler strips, manufactured from formed hot or cold rolled carbon steel channels with flange edges returned toward web, having a minimum of 2 stud, or I, anchors shop welded to the back of each channel, complying with ASTM A 1011. Provide channels, bolts, washers, and shims hot-dip galvanized per ASTM A 153/A 153M. Width, depth, and metal thickness as required to suit performance requirements.
- I. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

## 2.4 PAINT

- A. Shop Primer for Ferrous Metal: Organic zinc-rich primer, complying with SSPC-Paint 20 and compatible with topcoat.
  - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Carboline 621; Carboline Company.
  - b. Aquapon Zinc-Rich Primer 97-670; PPG Paints.
  - c. Tneme-Zinc 90-97; Tnemec Company, Inc.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

## 2.5 FASTENERS

- A. General: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36.
- D. Eyebolts: ASTM A 489.
- E. Machine Screws: ASME B18.6.3.
- F. Lag Bolts: ASME B18.2.1.
- G. Wood Screws: Flat head, carbon steel, ASME B18.6.1.
- H. Plain Washers: Round, carbon steel, ASME B18.22.1.
- I. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1.
- J. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
  - 1. Interior Expansion Anchor Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
  - 2. Exterior Expansion Anchor Material: Alloy Group 1 or 2 stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

## 2.6 GROUT

- A. Non-shrink, Non-metallic Grout: Factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.7 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble 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. Clearly mark units for reassembly and coordinated installation.
  - 1. Welded connections may be used where bolted connections are shown.
- B. Shear and punch metals cleanly and accurately. Remove burrs.
- C. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Weld corners and seams continuously along entire line of contact to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices and fasteners to secure metal fabrications rigidly in place and to support indicated loads.
- F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.
- H. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- I. Remove sharp or rough areas on exposed traffic surfaces.
- J. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous. Make up threaded connections tight so that threads are entirely concealed.
- K. Hot-dip galvanize all exterior ferrous metal fabrications embedded in concrete. Hot-dip galvanize all other items where specified or shown.

1. Exterior ferrous metal fabrications are defined as those items which are indicated to be installed in areas exposed to conditions which are not controlled by the building heating and cooling systems.
2. Interior ferrous metal fabrications are defined as those items which are indicated to be installed in areas exposed to conditions which are controlled by the building heating and cooling systems.

## 2.8 STEEL LADDERS

- A. General: Fabricate ladders for locations shown, with dimensions, spacings, details, and anchorages as indicated.
  1. Comply with ANSI A14.3, unless otherwise indicated.
  2. For elevator pit ladders, comply with ASME A17.1.
- B. Siderails: Continuous, 1/2 by 2-1/2 inch steel flat bars, with eased edges, spaced 18 inches apart.
- C. Bar Rungs: 3/4 inch square steel bars, spaced 12 inches o.c.
- D. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets. Size brackets to support design loads specified in ANSI A14.3.
- E. Provide non-slip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
- F. Provide non-slip surfaces on top of each rung by coating with abrasive material metallicly bonded to rung by a proprietary process.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Mebac; IKG Borden.
    - b. SLIP-NOT; W. S. Molnar Company.
- G. Galvanize exterior ladders; prime paint interior ladders.

## 2.9 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports indicated and as necessary to complete the Work and which are not a part of the structural framework, including but not limited to framing and supports for entrance and storefront frames, curtain wall secondary support framing, overhead rolling doors and grilles, countertop and vanities, projection screens, ceiling hung televisions and cameras, tube framing for partial height walls,, and mechanical and electrical equipment.



- 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.
- C. Countertop and Vanity Framing: Custom fabricate countertop and vanity framing, using steel shapes and plates, and cold finished mild steel bars at exposed conditions, for support framing and plywood, to the thicknesses, sizes and shapes shown, and as required to produce work of adequate strength and durability, without objectionable deflections. Use proven details of fabrication, as required, to achieve proper assembly and alignment of the various components of the work.
- D. Galvanize miscellaneous framing and supports at exterior locations; prime paint miscellaneous framing and supports at interior locations.

## **2.10 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 inches from each end, 6 inches from corners, and 24 inches o.c., unless otherwise indicated.

## **2.11 STEEL AND IRON FINISHES**

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
  - 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. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces by removing oil, grease, and similar contaminants in accordance with SSPC-SP 1 "Solvent Cleaning," followed with the SSPC surface-preparation specifications listed below and environmental exposure conditions of installed metal fabrications. Surface preparation shall be done after fabrication and immediately prior to shop painting. Apply shop coat of paint within 4 hours after cleaning and before rust bloom occurs.
  - 1. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
  - 2. Exteriors (SSPC Zone 1B): SSPC-SP 6, "Commercial Blast Cleaning."

- C. Apply a minimum of one coat of shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be field welded, and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
  - 2. Dry Film Thickness of Primer: 2.5 to 3.0 mils, dry film thickness. Apply paint thoroughly and evenly to dry surfaces, free from holidays and pinholes, in accordance with manufacturer's directions.

## **2.12 STAINLESS-STEEL FINISHES**

- A. Remove tool and die marks and stretch lines or blend into finish.
- B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- C. Bright, Directional Polish: No. 4 finish.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION, GENERAL**

- 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, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors. Drill holes for bolts to the exact diameter of the bolt. Provide screws threaded full length to the screw head.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Quality of Workmanship:
    - a. At concealed connections: No improvement from mill finish, except preparation necessary for priming is required. Welds are not required to be ground.
    - b. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness, pits, mill marks, nicks, or scratches show after finishing and contour of welded surface matches that of adjacent surface. Defects and distortions shall not be visible to the eye nor show through painted or polished surfaces.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

### **3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS**

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings, if any.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

### **3.3 ADJUSTING AND CLEANING**

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  1. Apply by brush or spray to provide a minimum 2.0 mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

**END OF SECTION**

## SECTION 05 52 13 - PIPE AND TUBE RAILINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Steel pipe and tube railings.

#### 1.2 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

#### 1.3 ACTION SUBMITTALS

- A. **CALgreen Submittals:**
1. Product Data for Section 5.504.4.1.1: Provide documentation for adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks, including printed statement of VOC content showing compliance with local or regional air pollution control or air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits as shown in CALgreen Tables 5.504.4.1 and 5.504.4.2.
  2. Product Data for Section 5.504.4.1.2: Provide documentation for aerosol adhesives, and smaller unit sizes of adhesives, sealant, and caulking compounds (in units of product, less packaging, which do not weigh more than one (1) pound and do not consist of more than sixteen (16) fluid ounces) comply with statewide VOC standards and prohibitions on use of certain toxic compounds, of CCR Title 17, commencing with Section 94507.
  3. Product Data for Section 5.504.4.3: For architectural paints and coatings, provide documentation including printed statement of VOC content showing compliance with Table 1 of the ARB, Architectural Coatings Suggested Control Measure, unless more stringent local limits apply.

4. Product Data for Section 5.504.4.3.1: Aerosol paints and coatings, provide documentation that products meet the PWMIR Limits for ROC in Section 94522 (a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Section 94522(c)(2 and (d)(2) of CCR Title 17.

- B. **Shop Drawings**: Include plans, elevations, sections, details, and attachments to other work.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.
- B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

#### **1.5 QUALITY ASSURANCE**

- A. Reference Standards: Comply with applicable provisions of the following:
  1. NAAMM "Metal Stairs Manual", AMP510.
  2. NAAMM "Pipe Railing Systems Manual, Including Round Tube," AMP521.
- B. Fabricator/Installer Qualifications: A firm experienced in producing handrails and railings similar to those indicated for this Project for a minimum of 5 years, with a record of successful in-service performance, with sufficient production capacity to produce required units without causing delay in the work.
  1. Employ only experienced tradesmen for both fabrication and installation, who are capable of producing work of the highest standards of quality in the industry.
- C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of handrails and railings that are similar to those indicated for this Project in material, design, and extent.
- D. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

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

- A. Store railings in a dry, well-ventilated, weathertight place. Deliver and handle so as to prevent any type of damage to the fabricated work.

## 1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with pipe and tube railings by field measurements before fabrication and indicate measurements on Shop Drawings.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
1. Steel: 72 percent of minimum yield strength.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  2. Infill of Guards:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
    - b. Infill load and other loads need not be assumed to act concurrently.
  3. Deflection Criteria: The larger deflections at the top from either the horizontal live loads or applicable wind loads shall be the lesser of 3/4-inch or  $h/90$  for cantilever elements, and  $h/175$  for simple span elements, where  $h$  is the distance from the floor level to the top of guardrail. Applied loads shall be allowable stress design loads.
- C. Exterior Metal Fabrications: All exterior metal railings shall be fabricated and installed to prevent buckling, opening up of joints and overstressing of welds and fasteners under the following temperature conditions:
1. Base fabrication on a temperature of +70 deg F at time of installation with allowance made for an exposed metal surface temperature range of -5 to +180 deg F.
    - . Make all necessary adjustments and provisions for concealed expansion.
- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

- E. Regulatory Requirements: Comply with the requirements of Part 1910 of the Occupational Safety and Health Standards (OSHA), the American Disabilities Act (ADA), and local regulatory requirements as applicable to stairs, handrails and the protection of openings; where regulatory requirements conflict the more stringent shall apply.
  - 1. Railing heights shall be consistent, in compliance with CBC 2019, Section 11B-505.4. Specific railing heights are indicated on Drawings.

## 2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without pitting, seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes where exposed to view on finished units.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

## 2.3 STEEL AND IRON

- A. General: Provide steel and iron (ferrous metal) in the form indicated, complying with the following requirements.
- B. Pipe: ASTM A 53/A 53M, Type S – Seamless, Grade A, suitable for close coiling or cold bending, Standard Weight (Schedule 40) minimum, unless another grade and weight are required to suit performance requirements.
  - 1. Galvanized finish for exterior installations and where indicated.
- C. Tubing: ASTM A 500 (cold formed) Grade A or ASTM A 513, unless otherwise indicated or required to satisfy the performance requirements.
- D. Plates, Shapes, and Bars: ASTM A 36/A 36M.
  - 1. Welded Headed Studs: AWS D1.1 (Type A or B as selected by fabricator), ASTM A 108 Grades 1010 through 1020 inclusive and bearing the minimum mechanical properties for studs as selected by fabricator to suit performance requirements.
- E. Cold Finished Steel Bars: ASTM A 108, grade as selected by fabricator.

## 2.4 FASTENERS

- A. General: Provide the following:
  - 1. Galvanized Steel Railings: Plated fasteners complying with ASTM B 633, or ASTM F 1941, Class Fe/Zn 12 for zinc coating.

- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of complying with the performance requirements.
- C. Post-Installed Anchors: Torque-controlled expansion or adhesive anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
  - 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12, unless otherwise indicated.

## 2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded .
- B. Shop Primer for Galvanized Steel: Zinc-dust, zinc-oxide primer formulated for priming zinc-coated steel and for compatibility with finish paint systems indicated, and complying with SSPC-Paint 5.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to comply with the performance requirements.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Shear, cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.



- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings. Weld connections continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove flux immediately.
  - 4. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay.
- I. Form changes in direction as indicated on the Drawings.
- J. Close exposed ends of railing members with prefabricated end fittings.
- K. Fabricate joints that will be exposed to weather in a watertight manner.
- L. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- M. Provide minimum 3/8 inch diameter weep holes or another means to drain entrapped water in hollow sections of railing members that are exposed to exterior or to moisture from condensation or other sources.

## **2.7 STEEL AND IRON FINISHES**

- A. Galvanized Railings: Hot-dip galvanize exterior steel and iron railings to comply with ASTM A 123. Hot-dip galvanize hardware for exterior steel and iron railings to comply with ASTM A 153/A 153M.
- B. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
  - 1. ASTM A 123, for galvanizing steel and iron products.
  - 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
  - 3. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
- C. 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.

- D. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- E. Primer Application: Apply shop primer to prepared surfaces of railings, except those with galvanized finishes and those to be field welded, unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  - 1. Stripe paint edges, corners, crevices, bolts, and welds.
  - 2. Dry Film Thickness of Primer: 2.5 to 3.0 mils, dry film thickness. Apply paint thoroughly and evenly to dry surfaces, free from holidays and pinholes, in accordance with manufacturers directions.
- F. Do not deliver primed railing work until primer has dried.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION, GENERAL**

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required to meet or exceed the performance requirements.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

#### **3.2 RAILING CONNECTIONS**

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

### **3.3 ANCHORING POSTS**

- A. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows.
  - 1. Anchor posts to steel by welding directly to steel supporting members.

### **3.4 ADJUSTING AND CLEANING**

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

### **3.5 PROTECTION**

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

**END OF SECTION**

## SECTION 05 52 13.16 - PIPE AND TUBE RAILINGS

### 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. Steel pipe and tube railings.
  2. Aluminum pipe and tube railings.
  3. Stainless-steel pipe and tube railings.
- B. Related Sections:
1. Section 05 51 12 "Metal Stairs" for steel tube railings associated with metal stairs.
  2. Section 05 73 00 "Decorative Metal Railings" for ornamental railings fabricated from pipes and tubes.
  3. Section 09 22 16 "Non-Structural Metal Framing" for metal backing for anchoring railings.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
1. Steel: 72 percent of minimum yield strength.
  2. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
  3. Stainless Steel: 60 percent of minimum yield strength.
- C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.

- c. Uniform and concentrated loads need not be assumed to act concurrently.
- 2. Infill of Guards:
  - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
  - b. Infill load and other loads need not be assumed to act concurrently.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Manufacturer's product lines of mechanically connected railings.
  - 2. Railing brackets.
  - 3. Grout, anchoring cement, and paint products.
- B. LEED Submittals:
  - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- D. Samples for Initial Selection: For products involving selection of color, texture, or design.
- E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- C. Welding certificates.

#### **ADDENDUM 3 RFI 45**

45. Q: Section 055213.16 paragraph 1.4B (and similar in other sections) mentions LEED criteria. Section 055213 paragraph 1.3A (and similar in other sections) mentions CALGreen submittals. Is the District pursuing either LEED or CAL green certification on this project? If so, please provide level certification pursuing and score card.

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- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

## 1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  - 3. AWS D1.6, "Structural Welding Code - Stainless Steel."
- D. Railing Standard: Comply with NAAMM "Pipe Railing Systems Manual Including Round Tube," AMP521.

## 1.7 PROJECT CONDITIONS

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

## 1.8 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by means that do not satisfy structural performance requirements.

## **PART 2 - PRODUCTS**

### **2.1 METALS, GENERAL**

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

### **2.2 STEEL AND IRON**

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- C. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
  - 1. Provide galvanized finish for exterior installations and where indicated.
- D. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- F. Expanded Metal: ASTM F 1267, Class 1 (uncoated).
- G. Perforated Metal: Cold-rolled steel sheet, ASTM A 1008/A 1008M, or hot-rolled steel sheet, ASTM A 1011/A 1011M, commercial steel Type B, 0.060 inch thick, with 1/4-inch holes 3/8 inch o.c. in staggered rows.
- H. Perforated Metal: Galvanized-steel sheet, ASTM A 653/A 653M, G90 coating, commercial steel Type B, 0.064 inch thick, with 1/4-inch holes 3/8 inch o.c. in staggered rows with 1/8-by-1-inch round end slotted holes in staggered rows.
- I. Woven-Wire Mesh: Intermediate-crimp, diamond pattern, 2-inch woven-wire mesh, made from 0.135-inch nominal diameter wire complying with ASTM A 510.

### **2.3 ALUMINUM**

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Bars and Tubing: ASTM B 221, Alloy 6063-T5/T52.

- C. Extruded Structural Pipe and Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.
  - 1. Provide Standard Weight (Schedule 40) pipe, unless otherwise indicated.
- D. Drawn Seamless Tubing: ASTM B 210, Alloy 6063-T832.
- E. Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- F. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6.
- G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.
- H. Perforated Metal: Aluminum sheet, ASTM B 209, Alloy 6061-T6, 0.063 inch thick, 1/4-inch holes 3/8 inch o.c. in staggered rows.
- I. Woven-Wire Mesh: Intermediate-crimp, diamond pattern, 2-inch woven-wire mesh, made from 0.162-inch nominal diameter wire complying with ASTM B 21, Alloy 6061-T94.

## 2.4 STAINLESS STEEL

- A. Tubing: ASTM A 554, Grade MT 304.
- B. Pipe: ASTM A 312/A 312M, Grade TP 304.
- C. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.
- D. Plate and Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.
- E. Expanded Metal: ASTM F 1267, Class 3 (corrosion-resistant steel), made from stainless-steel sheet, ASTM A 240/A 240M or ASTM A 666, Type 304.
- F. Perforated Metal: Stainless-steel sheet, ASTM A 240/A 240M or ASTM A 666, Type 304, 0.062 inch thick, with 1/4-inch holes 3/8 inch o.c. in staggered rows.
- G. Woven-Wire Mesh: Intermediate-crimp, square pattern, 2-inch woven-wire mesh, made from 0.135-inch nominal diameter wire complying with ASTM A 580/A 580M, Type 304.

## 2.5 FASTENERS

- A. General: Provide the following:
  - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for zinc coating.
  - 2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
  - 3. Aluminum Railings: Type 304 stainless-steel fasteners.
  - 4. Stainless-Steel Railings: Type 304 stainless-steel fasteners.



- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
  - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
  - 2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
  - 3. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
  - 1. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

## 2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
  - 1. For aluminum and stainless-steel railings, provide type and alloy as recommended by producer of metal to be welded and for color match, strength, and compatibility in fabricated items.
- B. Low-Emitting Materials: Paints and coatings 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."
- C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Shop Primers: Provide primers that comply with Section 099113 - Exterior Painting, Section 099123 - Interior Painting, and Section - 099600 High-Performance Coatings.
- F. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

- G. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- H. Shop Primer for Galvanized Steel: Water based galvanized metal primer complying with MPI#134.
- I. Intermediate Coats and Topcoats: Provide products that comply with Section 099113 -Exterior Painting, Section 099123- Interior Painting, and Section 099600- High-Performance Coatings.
- J. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.
- K. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.
- L. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- M. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- N. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
  - 1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

## 2.7 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap to receive finish hardware, screws, and similar items.

- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove flux immediately.
  - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
  - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- K. Form changes in direction as follows:
  - 1. As detailed.
  - 2. By radius bends of radius indicated.
- L. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- M. Close exposed ends of railing members with prefabricated end fittings.
- N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
- O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
  - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- Q. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

- R. For removable railing posts, fabricate slip-fit sockets from steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.
1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
- S. Expanded-Metal Infill Panels: Fabricate infill panels from expanded metal made from same metal as railings in which they are installed.
1. Edge panels with U-shaped channels made from metal sheet, of same metal as expanded metal and not less than 0.043 inch thick.
  2. Orient expanded metal with long dimension of diamonds vertical.
- T. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from same metal as railings in which they are installed.
1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than 0.043 inch thick.
  2. Orient perforated metal with pattern vertical.
- U. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch metal channel frames. Make wire mesh and frames from same metal as railings in which they are installed.
1. Orient wire mesh with wires perpendicular and parallel to top rail.
- V. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

## 2.8 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.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

## 2.9 STEEL AND IRON FINISHES

- A. Galvanized Railings:
1. Hot-dip galvanize exterior steel and iron railings, including hardware, after fabrication.
  2. Hot-dip galvanize indicated steel and iron railings, including hardware, after fabrication.
  3. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
  4. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
  5. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
  6. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.
- E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, Commercial Blast Cleaning.
- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel, for shop painting.
1. Shop prime uncoated railings with primers specified in Section 099113 - Exterior Painting and Section 099123- Interior Painting.
  2. Do not apply primer to galvanized surfaces.
- G. Shop-Painted Finish: Comply with Section 099113 - Exterior Painting.
1. Color: As indicated.
- H. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel, for shop painting. Apply at spreading rates recommended by coating manufacturer.
1. Color: As indicated.

## 2.10 ALUMINUM FINISHES

- A. Mechanical Finish: AA-M12 (Mechanical Finish: nonspecular as fabricated).
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- C. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
  - 1. Color: As selected by Architect from full range of industry colors and color densities.
- D. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - 1. Color and Gloss: As indicated.

## 2.11 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines, or blend into finish.
- B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- C. 180-Grit Polished Finish: Oil-ground, uniform, directionally textured finish.
- D. 320-Grit Polished Finish: Oil-ground, uniform, fine, directionally textured finish.
- E. Polished and Buffed Finish: Oil-ground, 180-grit finish followed by buffing.
- F. Directional Satin Finish: No. 4.
- G. Dull Satin Finish: No. 6.
- H. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

### 3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Pipe Railing Systems Standard: Comply with the applicable provisions and recommendations of the following publications by the National Association of Architectural Metal Manufacturer's (NAAMM):
  - 1. "Pipe Railing Systems Manual Including Round Tube", AMP521
- C. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  - 3. Handrail height shall be consistent per 2019 CBC §11B-505.4. CAS recommends specifying a midpoint height within the stated range: "Top of gripping surfaces of handrails shall be 34 inches (864 mm) minimum and 38 inches (965 mm) maximum vertically above walking surfaces, stair nosings, and ramp surfaces. Handrails shall be at a consistent height above walking surfaces, stair nosings, and ramp surfaces."
- D. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- E. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- F. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

### 3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

### 3.4 ANCHORING POSTS

- A. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

### **3.5 ATTACHING RAILINGS**

- A. Secure wall brackets and railing end flanges to building construction as follows:
1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
  2. For hollow masonry anchorage, use toggle bolts.
  3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
  4. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
  5. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
  6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

### **3.6 ADJUSTING AND CLEANING**

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

### **3.7 PROTECTION**

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

**END OF SECTION 05 52 13.16**



## SECTION 05 70 00 - DECORATIVE METAL

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Exterior trellis/sunshade assembly.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for non-decorative metal fabrications.
2. Section 09 96 00.13 "Exterior High Performance Coatings" for field finishing of steel components.

#### 1.2 COORDINATION

- A. Coordinate installation of anchorages for decorative metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

#### 1.3 ACTION SUBMITTALS

- A. **Product Data:** For each type of product indicated, including finishing materials.

B. **CALgreen Submittals:**

1. Product Data for Section 5.504.4.1.1: Provide documentation for adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks, including printed statement of VOC content showing compliance with local or regional air pollution control or air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits as shown in CALgreen Tables 5.504.4.1 and 5.504.4.2.
2. Product Data for Section 5.504.4.1.2: Provide documentation for aerosol adhesives, and smaller unit sizes of adhesives, sealant, and caulking compounds (in units of product, less packaging, which do not weigh more than one (1) pound and do not consist of more than sixteen (16) fluid ounces) comply with statewide VOC standards and prohibitions on use of certain toxic compounds, of CCR Title 17, commencing with Section 94507.
3. Product Data for Section 5.504.4.3: For architectural paints and coatings, provide documentation including printed statement of VOC content showing compliance with Table 1 of the ARB, Architectural Coatings Suggested Control Measure, unless more stringent local limits apply.

4. Product Data for Section 5.504.4.3.1: Aerosol paints and coatings, provide documentation that products meet the PWMIR Limits for ROC in Section 94522 (a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Section 94522(c)(2 and (d)(2) of CCR Title 17.
- C. **Shop Drawings:** Show fabrication and installation details for decorative metal.
  1. Include plans, elevations, component details, and attachments to other work.
  2. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
- D. **Samples for Verification:** For each type of exposed finish required.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified fabricator and finisher.
- B. Welding certificates.

#### 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Installer Qualifications: Fabricator of products.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
  1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store decorative metal in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.
- B. Deliver and store cast-metal products in wooden crates surrounded by sufficient packing material to ensure that products will not be cracked or otherwise damaged.

## 1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on shop drawings.

## PART 2 - PRODUCTS

### 2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. Provide materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

### 2.2 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
- B. Extruded Bars and Shapes: ASTM B 221, Alloy 6063-T5/T52.
  - 1. Extruded Sunshade Louvers: Profiles indicated on Drawings are based on products of Construction Specialties, Inc.
- C. Extruded Structural Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.
- D. Drawn Seamless Tubing: ASTM B 210 or ASTM B 483/B 483M, Alloy 6063-T832.
- E. Plate and Sheet: ASTM B 209, Alloy 5005-H32.

### 2.3 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold-formed).
- B. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

### 2.4 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
  - 1. Aluminum Items: Type 304 stainless-steel fasteners.

2. Uncoated-Steel Items: Plated steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed, Type 304 stainless-steel fasteners where exposed.
  3. Dissimilar Metals: Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.
- C. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work unless otherwise indicated.
1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- E. Post-Installed Anchors: Torque-controlled expansion type or chemical type.
1. Material for Exterior Locations: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

## 2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
1. For aluminum, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

## 2.6 FABRICATION, GENERAL

- A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- B. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

- D. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- E. Mill joints to a tight, hairline fit. Cope or miter corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.
- F. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as needed to receive finish hardware, screws, and similar items unless otherwise indicated.
- G. Comply with AWS for recommended practices in shop welding. Weld behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded joints of flux, and dress exposed and contact surfaces.
  - 1. Where welding cannot be concealed behind finished surfaces, finish joints to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 Welds: no evidence of a welded joint.

## **2.7 FINISHES, GENERAL**

- A. Decorative metal finishes are designated with Item Code MT# in the Finish Schedule and on the Drawings.
- B. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## **2.8 ALUMINUM FINISHES**

- A. High-Performance Organic Coating Finish: AA-C12C42R1x and the following:
  - 1. Polyvinylidene fluoride finish coating containing not less than 70 percent of "Kynar 500" or "Hylar 5000" fluorocarbon resin specially formulated for spray application to extrusions and preformed aluminum metal shapes. Remove die markings, scratches, abrasions, dents and other blemishes before applying finish. Coating films shall be uniform and visibly free from flow lines, streaks, blisters, sags or other surface imperfections in the dry-film state on all surfaces.
    - a. Metal Preparation and Pretreatment: Pretreatment of aluminum surface and application of the finish shall be performed under specifications issued by the licensed formulator to approved applicator and the following as a minimum:

- 1) The products used to form the chemical conversion coating on aluminum extrusions shall conform to ASTM D 1730, Type B, Method 5 (Amorphous Chromium Phosphate Treatment) or Method 7 (Amorphous Chromate Treatment), or Trivalent Chrome Treatment.
  - 2) The coating weight of the chemical conversion coating shall be a minimum of 40 mg. per sq. ft. on exposed surfaces as specified in ASTM B 449, Section 6, Class I. Processing shall conform to that specified in ASTM B 449, Section 5.
- b. Thickness:
- 1) Fluoropolymer 3-Coat Coating System: Minimum 1.6 mil total dry film thickness (0.25 mil primer +/- 0.05 mil and 1.35 mil topcoat).
- c. Coating Performance Criteria: Meets or exceeding AAMA 2605.
- d. Color: One custom color to be determined by Architect.
- e. Manufacturer, Coating System:
- 1) Three Coat, Opaque System; one of the following:
    - a) PPG Paints; Duranar XL.
    - b) Sherwin-Williams (formally Valspar, Inc.); Fluropon Classic.

## 2.9 STEEL AND IRON FINISHES

- A. Preparing Nongalvanized Items for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- B. Primer Application: Apply shop primer to prepared surfaces of items unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.
- B. Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.

- C. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.
- D. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- E. Install concealed gaskets, joint fillers, insulation, and flashings as work progresses.
- F. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.
  - 1. Retain protective coverings intact; remove coverings simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.
- G. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal arc welding and requirements for welding and for finishing welded connections in "Fabrication, General" Article. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
- H. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

### **3.2 CLEANING AND PROTECTION**

- A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.
- B. Clean copper alloys according to metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.
- C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- D. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.
- E. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

**Gensler**  
005.2882.000

January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

**END OF SECTION**



## SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes miscellaneous carpentry.

#### 1.2 ACTION SUBMITTALS

- A. **Product Data:** Submit product data for each type of process and factory-fabricated product indicated.
1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that materials comply with requirements.
- B. **CALgreen Submittals:**
1. Product Data for Section 5.504.4.1.1: Provide documentation for adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks, including printed statement of VOC content showing compliance with local or regional air pollution control or air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits as shown in CALgreen Tables 5.504.4.1 and 5.504.4.2.
  2. Product Data for Section 5.504.4.1.2: Provide documentation for aerosol adhesives, and smaller unit sizes of adhesives, sealant, and caulking compounds (in units of product, less packaging, which do not weigh more than one (1) pound and do not consist of more than sixteen (16) fluid ounces) comply with statewide VOC standards and prohibitions on use of certain toxic compounds, of CCR Title 17, commencing with Section 94507.
  3. Product Data for Section 5.504.4.3: For architectural paints and coatings, provide documentation including printed statement of VOC content showing compliance with Table 1 of the ARB, Architectural Coatings Suggested Control Measure, unless more stringent local limits apply.
  4. Product Data for Section 5.504.4.3.1: Aerosol paints and coatings, provide documentation that products meet the PWMIR Limits for ROC in Section 94522 (a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Section 94522(c)(2 and (d)(2) of CCR Title 17.
  5. Product Certificate for Section 5.504.4.5: Provide documentation as required in CALgreen Section 5.504.4.5.3, for hardwood plywood, particleboard and medium density fiberboard composite wood products showing compliance with requirements for formaldehyde as specified in ARB's Air Toxics Control Measure (ATCM) for Composite Wood.

### 1.3 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels; for lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

## PART 2 - PRODUCTS

### 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: Comply with DOC PS 20 "American Softwood Lumber Standard" and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
  - 3. Provide dressed lumber, S4S, unless otherwise indicated.
  - 4. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.
- B. Wood Panels:
  - 1. Plywood: Comply with DOC PS 1 "Construction and Industrial Plywood" for plywood panels. Use exterior grade for panels in wet conditions.
    - a. Plywood shall comply with requirements for formaldehyde as specified in ARB's Air Toxics Control Measure (ATCM) for Composite Wood. Those materials not exempted under the ATCM must meet the specified emission limits, as shown in Section 01 81 23 "CALgreen Requirements."
      - 1) Use composite wood products approved by the ARB as no-added formaldehyde (NAF) based resins or ultra-low emitting formaldehyde (ULEF) resins.
  - 2. Thickness: As needed to comply with requirements specified but not less than thickness indicated.

## 2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Provide chemical fire retardant process tested and labeled by UL with flame spread and smoke developed ratings of 25 or less. Comply with performance requirements in AWPA U1, Use Category UCFA as a minimum for pressure treatment. Size wood before treatment so that minimum cutting will be required after treatment. Kiln dry lumber to a maximum 19 percent moisture content, kiln dry plywood to a maximum 15 percent moisture content, after treatment. Treat indicated items and the following:
  - 1. Wood members required to be treated by Building Code having jurisdiction at the site and wood members specified as fire-retardant-treated.
- B. Fire-retardant-treated lumber and plywood shall comply with VOC content as shown in Section 01 81 23 "CALgreen Requirements."
- C. Identify fire-retardant-treated wood with appropriate classification marking of UL.

## 2.3 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber for support or attachment of other construction, including blocking, nailers, and similar members.
- B. For concealed boards, provide lumber with 19 percent maximum moisture content and the following species and grades:
  - 1. Mixed southern pine, No. 2 grade; SPIB.
  - 2. Western Woods; WCLIB or WWPA, No. 2 Grade.

## 2.4 PANEL PRODUCTS

- A. Concealed Plywood for Countertop Underlayment:
  - 1. APA Exterior sheathing, manufactured with no added urea-formaldehyde, in thickness as indicated but not less than 3/4 inch.
    - a. Roseburg Forest Products; Oregon Plywood 2 softwood plywood sheathing.
    - b. Roy O. Martin Lumber Company, Limited Partnership (MARTCO), Plywood Division; exterior softwood plywood sheathing.
    - c. Potlatch Forest Products Corporation, Forest Products Div., exterior softwood plywood sheathing.
- B. Telephone, Data, Security, and Electrical Equipment Backing Panels:
  - 1. APA, Exposure 1, C-C Plugged, fire-retardant treated, manufactured with no added urea-formaldehyde, in thickness indicated or, if not indicated, not less than 3/4 inch thick.

## 2.5 MISCELLANEOUS MATERIALS

- A. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional regulations as shown in Section 01 81 23 "CALgreen Requirements."
- B. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds shall comply with regulations as shown in Section 01 81 23 "CALgreen Requirements."

## 2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
- B. Power-Driven Fasteners: NES NER-272.
- C. Wood Screws: Select material, type, size, and finish required for each use. Comply with ASME B18.6.1.
- D. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- E. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- F. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
  - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.

- C. Use fasteners of appropriate type and length. Predrill members when necessary to avoid splitting wood.

### **3.2 WOOD BLOCKING AND NAILER INSTALLATION**

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

### **3.3 PANEL PRODUCT INSTALLATION**

- A. General: Comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial," and local utility requirements, if any, for plywood backing panels utilized as indicated.
- B. Fastening Methods: Fasten panels as indicated below:
  - 1. Countertop Underlayment: Bolt to miscellaneous steel framing.
  - 2. Plywood Backing Panels: Secure to wall using proper fastening devices for substrates encountered spaced 12 inches on center maximum at perimeter 1/2 inch from corners and three rows of 3 fasteners each in the backerboard field. Countersink fasteners flush with plywood surface. Butt adjacent panels without lapping.

**END OF SECTION**

## SECTION 06 16 00 - SHEATHING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Wall sheathing.
  2. Parapet sheathing.
  3. Sheathing joint and penetration treatment.

#### 1.2 ACTION SUBMITTALS

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

#### 1.3 DELIVERY, STORAGE, AND HANDLING

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

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

#### 2.2 WALL SHEATHING

- A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Continental Building Products, LLC.
    - c. Georgia-Pacific Gypsum LLC.

- d. National Gypsum Company.
- e. Temple-Inland Building Products by Georgia-Pacific.
- f. USG Corporation.

2. Type and Thickness: Regular, 1/2 inch thick.

### 2.3 PARAPET SHEATHING

- A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CertainTeed Corporation.
  - b. Georgia-Pacific Gypsum LLC.
  - c. National Gypsum Company.
  - d. Temple-Inland Building Products by Georgia-Pacific.
  - e. USG Corporation.
2. Type and Thickness: Regular, 1/2 inch thick.

### 2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  1. For parapet wall sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
  1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C1002.
  2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C954.

## 2.5 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
  - 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  - 1. ICC-ES evaluation report for fastener.
- D. Coordinate wall parapet sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

### 3.2 GYPSUM SHEATHING INSTALLATION

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



3. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.
  1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
- D. Seal sheathing joints according to sheathing manufacturer's written instructions.
  1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
  2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

**END OF SECTION**

## SECTION 06 40 23 - INTERIOR ARCHITECTURAL WOODWORK

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes interior architectural woodwork:
  - 1. Plastic-laminate cabinets.
  - 2. Solid-surfacing material countertops.
  - 3. Quartz-surfacing material countertops.
- B. Related Requirements:
  - 1. Section 05 50 00 "Metal Fabrications" for concealed countertop supports.

#### 1.2 ACTION SUBMITTALS

- A. **Product Data:** Submit product data for each material and product specified and incorporated into items of architectural woodwork during fabrication, finishing, and installation.
  - 1. Cabinet hardware and accessories.
  - 2. Finishing materials and processes.
- B. **CALgreen Submittals:**
  - 1. Product Data for Section 5.504.4.1.1: Provide documentation for adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks, including printed statement of VOC content showing compliance with local or regional air pollution control or air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits as shown in CALgreen Tables 5.504.4.1 and 5.504.4.2.
  - 2. Product Data for Section 5.504.4.1.2: Provide documentation for aerosol adhesives, and smaller unit sizes of adhesives, sealant, and caulking compounds (in units of product, less packaging, which do not weigh more than one (1) pound and do not consist of more than sixteen (16) fluid ounces) comply with statewide VOC standards and prohibitions on use of certain toxic compounds, of CCR Title 17, commencing with Section 94507.
  - 3. Product Data for Section 5.504.4.3: For architectural paints and coatings, provide documentation including printed statement of VOC content showing compliance with Table 1 of the ARB, Architectural Coatings Suggested Control Measure, unless more stringent local limits apply.
  - 4. Product Data for Section 5.504.4.3.1: Aerosol paints and coatings, provide documentation that products meet the PWMIR Limits for ROC in Section 94522 (a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Section 94522(c)(2) and (d)(2) of CCR Title 17.

5. Product Certificate for Section 5.504.4.5: Provide documentation as required in CALgreen Section 5.504.4.5.3, for hardwood plywood, particleboard and medium density fiberboard composite wood products showing compliance with requirements for formaldehyde as specified in ARB's Air Toxics Control Measure (ATCM) for Composite Wood.
  - a. Use composite wood products approved by the ARB as no-added formaldehyde (NAF) based resins or ultra-low emitting formaldehyde (ULEF) resins.
- C. **Shop Drawings:** Submit shop drawings showing locations of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components. Elevations shall be drawn at a scale of not less than  $1/2" = 1'-0"$ . Details shall be drawn at a scale of not less than  $3" = 1'-0"$ .
  1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
  2. Show locations and sizes of cutouts and holes for plumbing, electrical, computer and telephone equipment and other items installed in architectural woodwork.
- D. **Samples:** Submit samples of the following:
  1. Five veneer leaves representative of and selected from each flitch to be used for transparent-finished woodwork.
  2. Three 12 inch by 12 inch sample sets containing a minimum of two or more samples of transparent finished wood-veneer and plastic laminate veneered panel products, fabricated from each core product, for each veneer specified and demonstrating the proposed full range of appearance characteristics to be expected in completed work. Include at least one face-veneer seam in each sample.
  3. Thermoset decorative-overlay surfaced panel products, for each type, color, pattern, and surface finish.
  4. Solid-surfacing materials, 6 inches square.
  5. Quartz-surfacing materials, 6 inches square.

### 1.3 CLOSEOUT SUBMITTALS

- A. **Maintenance Instructions:** Submit maintenance instructions for all countertop materials. Where countertop materials are recommended to be protected with hot pads, provide manufacturers properly sized for the hot equipment designed to be placed thereon.

#### **1.4 QUALITY ASSURANCE**

- A. Single-Source Manufacturing and Installation Responsibility: Engage a qualified Manufacturer - acceptable to the Architect - to assume undivided responsibility for woodwork specified in this Section, including fabrication, finishing, and installation. The manufacturer shall have a minimum of 15 years successful experience in the custom fabrication and installation of architectural woodwork comparable to that shown and specified, be a member of the AWI, maintain an organized quality control program, perform its own in-house veneer lay-up work, and who retains facilities with sufficient capacity and quality to produce the required architectural woodwork without causing delay to the Project.
- B. Quality Standard: Fabricate and install all architectural woodwork in accordance with the applicable requirements of Architectural Woodwork Standards, 2nd edition, published jointly by AWI, AWMAC, and WI, unless more stringent requirements are specified or shown.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration. Do not deliver woodwork until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Field Conditions" Article.

#### **1.6 FIELD 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 levels planned for building occupants during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify actual dimensions of other construction by accurate field measurements before fabrication of woodwork; and indicate measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on shop drawings.

#### **1.7 COORDINATION**

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. General: Provide materials that comply with requirements of the AWS quality standard for each type of woodwork and quality grade specified.
- B. Composite wood products shall comply with requirements for formaldehyde as specified in ARB's Air Toxics Control Measure (ATCM) for Composite Wood. Those materials not exempted under the ATCM must meet the specified emission limits, as shown in Section 01 81 23 "CALgreen Requirements."
  - 1. Use composite wood products approved by the ARB as no-added formaldehyde (NAF) based resins or ultra-low emitting formaldehyde (ULEF) resins.
- C. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional regulations as shown in Section 01 81 23 "CALgreen Requirements."
- D. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds shall comply with regulations as shown in Section 01 81 23 "CALgreen Requirements."
- E. Lumber Standards: Comply with applicable provisions for grading and workmanship of AWS Architectural Woodwork Standards, Section 3, and the requirements shown and specified; where standards conflict the more stringent shall apply. Provide lumber surfaced 4 sides (S4S) and fabricated to profiles shown. All lumber shall be kiln dried to the moisture content indicated in AWS, Section 2.
  - 1. Furring, Blocking, Shims: No. 1 Common; Southern Pine.
- F. Wood Panel Products:
  - 1. Medium-Density Fiberboard (non-moisture resistant): A sustainable, medium density fiberboard (MDF) panel manufactured from minimum 92 percent preconsumer recycled wood fiber complying with ANSI A208.2, Grade 155, having a minimum 47 pcf density except that minimum for screw holding capacity on face shall be 300 pounds; an ASTM E 84 minimum Class C flame spread rating, minimum 3/4 inches thick, edged and faced as specified, fabricated with binder containing no added urea formaldehyde.
    - a. Roseburg Forest Products; NAUF Medite II.

2. Medium-Density Fiberboard (moisture resistant): A sustainable, moisture-resistant, medium density fiberboard (MDF) panel manufactured from minimum 92 percent preconsumer recycled wood fiber complying with ANSI A208.2, Grade 155, having a minimum 48 pcf density except that minimum for screw holding capacity on face shall be 325 pounds; an ASTM E 84 Class C flame spread rating, minimum 3/4 inches thick, edged and faced as specified, fabricated with binder containing no added urea formaldehyde.
    - a. Roseburg Forest Products; NAUF Medex.
  3. Hardboard: ANSI A135.4.
- G. Thermoset Decorative Overlay (Melamine): Particleboard or medium-density fiberboard with surface of thermally fused, melamine-impregnated decorative paper complying with the recommendations of the Composite Panel Association's Technical Bulletin "Laminating Composite Panels."
1. Types: As indicated in the Finish Schedule on the Drawings.
- H. High-Pressure Decorative Laminate (PL##): Complying with NEMA LD 3 for Horizontal General Purpose Grade (HGS) typically and Vertical General Purpose Grade (VGS) where specified. Nominal thickness for HGS and VGS laminates to be 0.048 inches +/-0.005 inches and 0.028 inches +/- 0.004 inches, respectively. Where high pressure decorative laminate is indicated to be faced with aluminum, provide aluminum sheet goods specifically made for laminating to vertical MDF and particleboard substrates in sheet thickness of 0.025 inches +/- 0.002 inches.
1. Types: As indicated in the Finish Schedule on the Drawings.
    - a. Provide factory applied protective peel coat to prevent surface damage during fabrication and handling of aluminum faced decorative laminates. Remove protective peel coat after installation in accordance with the manufacturer's recommendations. If the film is left in place after installation, exposure to direct sunlight for a prolonged period may cause a paste residue and create other problems.
  2. Backing Sheets: Non-decorative, high pressure laminate, NEMA LD3, Grade, types and thickness to match face sheets and equalize pull.
- I. Solid-Surfacing Material (SC##): Provide material that meets or exceeds ISFA-2-01 performance standards, consisting of reacted monomers and resins, mineral fillers and pigments and manufactured in sheets of specific thicknesses. Solid surfacing material shall be solid, non-porous, homogeneous, hygienic, renewable, and, when applicable, may feature inconspicuous hygienic seams. Solid surfacing material shall be free from conspicuous internal strengthening fibers.
1. Types: As indicated in the Finish Schedule on the Drawings.

- J. Quartz-Surfacing Material (SC##): Provide material that meets or exceeds National Sanitation Foundation 51 Food Zone Compliance standards, consisting of quartz crystals and proprietary binders and manufactured in sheets of specific thicknesses. Quartz surfacing material shall be solid, non-porous, homogeneous, hygienic, renewable, and, when applicable, may feature inconspicuous hygienic seams. Quartz surfacing material shall be free from conspicuous internal strengthening fibers.
1. Products: Subject to compliance with requirements, provide products scheduled on Drawings.
- K. Adhesives, General: Use only low emitting VOC adhesives that leave no glue lines on finished surfaces of architectural woodwork. Do not use adhesives that contain urea formaldehyde.
1. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-retardant-treated lumber and plywood shall comply with VOC content as shown in Section 01 81 23 "CALgreen Requirements."

## 2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials for a complete installation of architectural woodwork, except for items specified in Section 08 71 00 "Door Hardware."
- B. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.
- C. Frameless Concealed Hinges for Cabinet Doors (European Type): Concealed all-metal furniture hinges adaptable or engineered for 35 mm hinge cup boring pattern, with minimum 155 degree opening angle, three-dimensional hinge having adjustments located in the steel hinge arm, steel or die-cast zinc hinge cups, mounting plates, and plastic insertion dowels to receive hinge screws. Automatic soft closing shall engage only in the last 10 degrees of swing. All hinge pins and linkages shall be hardened. Complying with BHMA A156.9, B01602. Bright nickel finish (US15).
1. Hinge Quantity: Provide hinge quantity as recommended by hinge manufacturer based on cabinet door width, weight, thickness, door material, and hinge cup selection.
  2. Metal Furniture Hinge Products and Manufacturers: One of the following:
    - a. Basis of Design: Grass Tiomos Series; Grass America, Inc.; Kernersville, NC.
    - b. Blumotion Series; Blum USA; Stanley, NC.
    - c. Salice; Silencia Series 200.

- D. **Flat Top Pulls: Solid stainless steel pull, 6-11/16 inches long, with 1-3/8-inch projection ;** satin finished stainless steel (US32D); provide the following:
1. **DP129-SSS Flat Top Pull;** Doug Mockett and Co., Inc.
- E. Catches: Magnetic, complying with BHMA A156.9, B03141 for single doors and B03161 for double doors.
1. For Single Doors: One of the following:
    - a. CD41 Single Magnetic Cabinet Catch; Stanley Commercial Hardware.
    - b. 900; Rockwood Manufacturing Company, Rockwood, PA.
    - c. 246.94.701 housing x 246.94.702 counterpiece; Hafele America Co. Archdale, NC.
  2. For Double Doors: One of the following:
    - a. 901; Rockwood Manufacturing Company.
    - b. CD45 Double Magnetic Cabinet Catch; Stanley Commercial Hardware.
- F. Cabinet Shelf Rests: Nickel plated brass or steel, or stainless steel, minimum 6 mm diameter shelf support pegs in sockets, complying with BHMA A156.9, B04013. One of the following:
1. Hafele 282.01.701 x 282.50.704; Hafele America, Co.
  2. K-10S with K-2 Sleeve; Brusso, Inc.
  3. 331 Series Flat Top Shelf Support Pin with 325 Series Insert Grommet; Knappe and Vogt.
- G. Drawer Slides:
1. Drawers less than 4 inches deep: Similar to Accuride 7432 having full extension carburized steel ball bearing, side mounting, 100 pound capacity medium duty load rating, cold rolled steel slide members and ball retainers, cushioned in and outstops, detent-in, progressive action, positive stop, bright electro zinc plate finish.
  2. Drawers greater than 4 inches but less than 8 inches deep: Similar to Accuride 7432 having full extension carburized steel ball bearing, side mounting, 100 pound capacity medium duty load rating, cold rolled steel slide members and ball retainers, cushioned in and outstops, detent-in, progressive action, positive stop, bright electro zinc plate finish.
  3. Drawers greater than 8 inches deep: Similar to Accuride 4032 having full extension carburized steel ball bearing, rail mounting, 150 pound capacity heavy duty load rating, cold rolled steel slide members and ball retainers, cushioned in and outstops, detent-in, progressive action, positive stop, bright electro zinc plate finish.
  4. Refuse Cabinets: Similar to Accuride 3600-201 having full extension carburized steel ball bearing, bottom mounting, 175 pound capacity heavy duty load rating, cold rolled steel slide members and ball retainers, cushioned in and outstops, progressive action, positive stop, bright electro zinc plate finish.
  5. Accuride International, S.A. de C.V., Mexicali, B.C., C.P. 21395 Mééxico.



- H. Silencers: Provide rubber silencers on jamb and/or head and sill strike areas of all cabinet doors and drawers, 2 for paired doors, and 3 for single doors. Silencers shall be approximately 1/4-inch diameter, color compatible with adjacent finish.
- I. Door and Drawer Locks: All cabinet doors and drawers shall be furnished with locks. Finish exposed portions of locks to match cabinet pull finish. Furnish 2 keys with each lock and key all locks inside one room alike and provide masterkey for all locks in Project.
1. Drawers: Provide one of the following lock assemblies:
    - a. Cam lock similar to Hafele 235.10.261, 1-3/16 inch cylinder length, chrome plated, with straight and offset cams; Hafele America, Co., Archdale, NC.
    - b. Cam lock similar to CompX Type 170 Thick Panel Lock x LP-700 lock plug, satin nickel finish, with surface-mounted strike plate SP-100; CompX Timberline, Neenah, WI.
  2. Single Doors: Provide one of the following lock assemblies:
    - a. Latch lock similar to Olympus 998/999 Series x 999-Strike, chrome plated, sized to fit opening; Olympus Lock, Inc., Lynnwood, WA.
    - b. Deadbolt similar to CompX CB-281 cylinder body x LP-700 lock plug, satin nickel finish, with surface-mounted strike plate SP-100; CompX Timberline, Neenah, WI.
  3. Pairs of Doors: Provide the following:
    - a. At inactive leaf, Furniture bolt similar to Hafele 252.02.644, polished chrome, with strike 251.60.703; Hafele America, Co.
    - b. At active leaf, provide Single Door lock assembly.
- J. Exposed Hardware Finishes: Unless otherwise specified above, or on the Drawings, all exposed portions of the woodwork hardware shall comply with BHMA A156.18 for BHMA finish number indicated.
1. Satin Stainless Steel: BHMA 630.
- K. Steel Reinforcing: Carbon steel shapes, tubes and plates complying with ASTM A 36 (shapes and plates), and ASTM A 500 or A 501 (for tubes).
1. Shop Primer for Concealed Steel Reinforcing: Provide fast curing, lead and chromate free, universal modified alkyd primer complying with performance requirements in FS TT-P-664.
  2. Electrodes for Concealed Steel Reinforcing: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded.
- L. Screws: Select material, type, size, and finish required for each use. Comply with ASME B18.6.1.
- M. Nails, Wire, Brads, and Staples: Select material, type, size, and finish required for each use.

1. ASTM F 1667 for driven fasteners such as nails, spikes and staples.
  2. ASTM F 547 for nails used with wood and wood based products.
- N. Anchors: Select material, type, size, and finish required by each substrate for secure anchorage. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors.
- O. Blind Splines: Specialty devices, as required for tight butt joining, types and size as recommended by woodwork fabricator.
- P. Covercaps: Where mortises of fastener heads, or draw downs are exposed (blind holes) in finished work, provide black plastic covercaps.

## **2.4 FABRICATION, GENERAL**

- A. General: Complete fabrication, including assembly, finishing, and hardware application, before shipment to Project site to the maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting. The width of scribe and filler panels shall not exceed 1/2 inch, or 1/2 inch clear dimension from adjacent wall to outside face of cabinet door in a 90 degree position, whichever is greater.
1. Interior Woodwork Grades:
    - a. Custom Grade at plastic laminate-finished woodwork
- B. Fabricate woodwork to dimensions, profiles, and details indicated.
1. Reinforcing shown is minimum. Provide additional steel and lumber reinforcing as required to sustain imposed loads and to ensure a rigid assembly.
  2. Exposed surfaces shall be free from dents, tool marks, warpage, buckle, glue and open joints, or other defects affecting serviceability or appearance. Accurately fit all joints, corners and miters. Conceal all fasteners. Make threaded connections up tight so that threads are entirely concealed.
- C. 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. Seal edges of openings in countertops with a coat of varnish.

## **2.5 WOOD CABINETS FOR PLASTIC LAMINATE FINISH**

- A. AWS Type of Cabinet Construction: Flush overlay.
- B. Laminate Cladding for Exposed Surfaces: High-pressure decorative of grade indicated.

1. Horizontal Surfaces Other Than Tops: HGS.
  2. Postformed Surfaces: HGP.
  3. Vertical Surfaces: VGS.
  4. Edges: HGS unless otherwise indicated.
  5. Colors, Patterns, and Finishes: As indicated on the Drawings and in the Finish Schedule.
- C. Materials for Semiexposed Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
1. Drawer Sides and Backs: Solid-hardwood lumber.
  2. Drawer Bottoms: Hardwood plywood.
- D. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.
- E. Cabinet Locks: Provide door and drawer locks.

ADDENDUM 3 - RFI 10 RESPONSE  
A: Spec section 064023/1.4.B states "...unless more stringent requirements are specified or shown.". Details on A5.901 call out the design intent of the millwork.

## 2.6 SOLID SURFACING COUNTERTOPS (SS##)

- A. General: Comply with AWS Section 11 and as follows.
- B. Solid-Surfacing-Material Thickness: 1/2 inch.
- C. Colors, Patterns, and Finishes: As indicated on the Drawings and in the Finish Schedule.
- D. Factory fabricate components to achieve required shapes, sizes, and profiles shown, without cracks, spalling, pits, surface porosity, chipped areas, or blisters.
  1. Form all tops in one piece lengths. Provide adhesively bonded backsplashes and aprons in heights indicated. Form edges to profiles shown. If required, use 2 sheets of countertop sheet material laminated together using manufacturer's standard adhesive to form edges. Laminated sections shall be in close contact throughout. Adhesive stains will not be permitted.
  2. Provide separate 6 inch high end splashes.
  3. Countertops shall be factory cored for plumbing fittings provided under Division 22 Plumbing or as indicated on the Drawings.
- E. Radius corners and edges. Provide 1/8 inch radius.
- F. Finish exposed surfaces by trimming and grinding smooth.

## 2.7 QUARTZ SURFACING MATERIAL COUNTERTOPS (SS##)

- A. General: Comply with AWS Section 11 and as follows.
- B. Surfacing-Material Thickness: 1-1/8 inch.

- C. Radius corners and edges. Provide 1/8 inch radius.
- D. Colors, Patterns, and Finishes: As indicated by manufacturer's designations in Finish Schedule.
- E. Fabricate tops in one piece, unless otherwise indicated. Comply with quartz-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

## 2.8 SHOP FINISHING

- A. Production finish architectural woodwork at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- B. Priming of interior architectural woodwork with field applied opaque finish required to be performed at fabrication shop are specified in this Section. Refer to Section 09 91 23 "Interior Painting" for finishing opaque finished architectural woodwork.
- C. Preparations 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, backing paper, or thermoset decorative overlay.
  - 2. Gluing of face veneers shall, where possible, be by the hot plate method; glued surfaces shall be in close contact throughout. Glue stains will not be permitted.
  - 3. Grain of all transparent finished wood shall run in the direction shown, or if not shown, as accepted on the shop drawings.
- D. Exposed Surfaces:
  - 1. Plastic Laminate Finish: Gluing of plastic laminate surfacing materials shall be by the hot plate method, glued surfaces shall be in close contact throughout. Glue stains shall not be permitted.
- E. Unexposed Wood Finish: Shop-applied alkyd type primer-sealer.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas.

- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming before installation.

### 3.2 INSTALLATION

- A. Quality Standard: Install woodwork to comply with requirements of the AWS for the same grade specified in this Section for type of woodwork involved.
  - 1. Install woodwork level, plumb, true, with no distortions, and with no variations in flushness of adjoining surfaces. Shim as required with concealed shims.
  - 2. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.
- B. Anchor woodwork to blocking built in or directly attached to substrates. Secure to blocking 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.
- C. Cabinets: 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 without sag, bow, or other variation from a straight line.
  - 2. Maintain veneer sequence matching of cabinets with transparent finish.
  - 3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches on center with No. 10 wafer-head screws sized for 1-inch penetration into wood blocking, or hanging strips or with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
- D. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
  - 1. Calk space between backsplash and wall with silicone sanitary sealant specified in Section 07 92 00 "Joint Sealants."
  - 2. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
  - 3. Secure backsplashes to tops with concealed metal brackets at 16 inches on center and to walls with adhesive.
- E. Complete the finishing work specified in this Section to extent not completed at shop or before installation of woodwork.

### 3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

- B. Clean woodwork on exposed and semiexposed surfaces. Touchup shop-applied finishes to restore damaged or soiled areas.

### **3.4 PROTECTION**

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer, that ensures that woodwork will be without damage or deterioration at time of Substantial Completion.

**END OF SECTION**

## SECTION 07 21 00 - THERMAL INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Polyisocyanurate foam-plastic board.
2. Glass-fiber blanket.
3. Mineral-wool board.
4. Loose-fill insulation.
5. Spray-applied insulation.

B. Related Requirements:

1. Section "Wall Cladding Attachment System" for metal girt system installed over continuous insulation.
2. Section 06 16 00 "Sheathing" for foam-plastic board sheathing installed directly over wood or steel framing.
3. for insulation specified as part of roofing construction.
4. Section 09 29 00 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

#### 1.2 ACTION SUBMITTALS

A. **Product Data:** For each type of product.

B. **CALgreen Submittals:**

1. Product Data for Section 5.504.4.1: For sealants, adhesives and caulks, provide documentation including printed statement of VOC content showing compliance with SCAQMD Rule 1168 VOC limits and CCR (California Code of Regulations) Title 17 for aerosols.
2. Product Data for Section 5.504.4.1.2: Provide documentation for aerosol adhesives, and smaller unit sizes of adhesives, sealant, and caulking compounds (in units of product, less packaging, which do not weigh more than one (1) pound and do not consist of more than sixteen (16) fluid ounces) comply with statewide VOC standards and prohibitions on use of certain toxic compounds, of CCR Title 17, commencing with Section 94507.

C. **Low-emitting product certification.**

#### 1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

- B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

#### **1.4 QUALITY ASSURANCE**

- A. Surface-Burning Characteristics: As determined by testing protocol required to achieve UL Classified rating. Identify products with appropriate markings of Underwriters Laboratories.
- B. Formaldehyde-Free: Third Party Certified with UL Environmental Validation.
- C. Recycled Content: A minimum of 50 (or highest available) percent post-consumer recycled glass content, UL-validated.
- D. Low-Emitting Materials: For all thermal and acoustical applications of glassinsulation products, provide materials complying with the testing and products requirements of UL Environmental Validation and UL GreenGuard Gold certification.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
  - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
  - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
  - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

### **PART 2 - PRODUCTS**

#### **2.1 POLYISOCYANURATE FOAM-PLASTIC BOARD**

- A. Polyisocyanurate Board, Foil Faced: ASTM C 1289, foil faced, Type I, Class 1 or 2.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dow Chemical Company (The); Thermax.
    - b. RMax; TSX-8500.
    - c. RMax; ECOMAXci.



2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
3. Must comply with Section 2603.5.1 through 2603.5.7 of the CBC for Types I-IV construction.
4. Flame spread of 25 or less and smoke developed index of 450 or less in accordance with ASTM E 84 or UL 723.

## 2.2 GLASS-FIBER BLANKET

- A. Manufacturers: Subject to compliance with requirements, product products by one of the following:
  1. CertainTeed Corporation
  2. Johns Manville.
  3. Knauf Insulation; EcoBatt Insulation with Ecosse Technology.
  4. Owens Corning.
- B. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
  1. Free of Formaldehyde: Insulation manufactured with formaldehyde-free binder.
  2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.
- C. Recycled Content of Insulation: Postconsumer recycled content not less than .
- D. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

## 2.3 MINERAL-WOOL BOARD

- A. Manufacturers: Subject to compliance with requirements, product products by one of the following:
  1. ROCKWOOL.
  2. Thermafiber, Inc.; an Owens Corning company.
- B. Recycled Content of Insulation: Postconsumer recycled content not less than 50 percent (or highest available).
- C. Mineral-Wool Board, Type III, Unfaced: ASTM C 612, Type III, IVA and IVB; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. Nominal density of 8 lb/cu. ft., thermal resistivity of 4.35 deg F x h x sq.ft./Btu x in. at 75 deg F.
  1. Rockboard 80.

- D. Mineral-Wool Board, Type IVB, Faced: ASTM C 612, Type III; faced on one side with foil-scrim or foil-scrim-polyethylene vapor retarder; with maximum flame-spread and smoke-developed indexes of zero and zero, respectively, per ASTM E 84. Nominal density of 11 lb/cu. ft..
1. Comfortboard CIS (exterior curtain walls).

## 2.4 SPRAY-APPLIED INSULATION

- A. Manufacturers: Subject to compliance with requirements, product products by one of the following:
1. International Cellulose Corp.; K-13.
  2. Monoglas Incorporated.
- B. Self-Supported, Spray-Applied Insulation< Insert drawing designation>: ASTM C 1149, Type II (materials containing a dry adhesive activated by water during installation; intended only for enclosed or covered applications), chemically treated for flame-resistance, processing, and handling characteristics.

## 2.5 INSULATION FASTENERS

- A. Manufacturers: Subject to compliance with requirements, product products by one of the following:
1. AGM Industries, Inc.
  2. Gemco.
  3. Rodenhouse, Inc.
- B. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.
- C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
    - a. Crawl spaces.
    - b. Ceiling plenums.

- D. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of 2 inches between face of insulation and substrate to which anchor is attached.
- E. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.
- F. Insulated sheathing manufacturer's recommended polymer or other corrosion protective coated steel screw fasteners for anchoring sheathing to metal wall framing. Fastener length and size based on wall sheathing thickness.

## 2.6 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
  - 1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
- B. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional regulations as shown in Section 01 81 23 "CALgreen Requirements."
- C. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds shall comply with regulations as shown in Section 01 81 23 "CALgreen Requirements."

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

### 3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

### **3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION**

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
  - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
  - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
  - 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
  - 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..
- C. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

### **3.4 INSTALLATION OF CONTINUOUS INSULATION**

- A. Install insulation in accordance with manufacturer's recommendations. Fasten to exterior face of exterior metal stud wall framing or cmu wall using sheathing manufacturer's recommended type and length screw fasteners with washers. Abut panels tightly together and around openings and penetrations.

### **3.5 INSTALLATION OF CURTAIN-WALL INSULATION**

- A. Install board insulation in curtain-wall construction according to curtain-wall manufacturer's written instructions.

1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
2. Install insulation to fit snugly without bowing.

### **3.6 PROTECTION**

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

**END OF SECTION**

## SECTION 07 21 65 - WALL CLADDING ATTACHMENT SYSTEM

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Provide a thermally broken system for attachment of exterior cement plaster installed over continuous exterior-insulation.
- B. Related Sections:
  - 1. Section 05 40 00 "Cold-formed Metal Framing" for wall framing.
  - 2. Section 06 16 00 "Sheathing" for wall sheathing.
  - 3. Section 07 27 26 "Fluid-Applied Membrane Air Barriers" for air and moisture barriers applied over sheathing.
  - 4. Section 07 21 00 "Thermal Insulation" for exterior continuous insulation.
  - 5. Section 07 25 00 "Weather Barriers" for building paper installed over continuous insulation.
  - 6. Section 09 24 00 "Cement Plastering" for lath and plaster.

#### 1.2 SYSTEM DESCRIPTION

- A. System assembly shall include the following components from the substrate out:
  - 1. Substrate: Wall framing assembly and sheathing.
  - 2. Weather Resistant/Air Barrier over sheathing.
  - 3. Continuous insulation and weather barrier.
  - 4. Thermally broken cladding attachment system.
  - 5. Exterior plaster assembly.
- B. Design Requirements:
  - 1. Manufacturer is responsible for designing system, including anchorage to structural system and necessary modifications to meet specified requirements and maintain visual design concepts.
  - 2. Employ registered professional engineer, licensed to practice engineering in jurisdiction where Project is located, to engineer each component of rainscreen attachment system.
  - 3. Structural Design: Exterior-insulated wall assembly capable of withstanding effects of load and stresses from dead loads, wind loads, as indicated on Structural General Notes on Structural Drawings, and normal thermal movement without evidence of permanent defects of assemblies or components.
    - a. Thermal Movements: Provide assemblies that allow for thermal movements resulting from the following maximum ambient temperatures by preventing overstressing of components and other detrimental effects:

- 1) Temperature Change (range): 120 degrees Fahrenheit, ambient:
4. Support Framing/Attachment System:
    - a. No framing component may penetrate the layer of continuous exterior insulation other than thermally isolated fasteners.
    - b. Frequency and spacing of stiffened horizontal girts as indicated by manufacture in project specific engineering package.
- C. Performance Requirements:
1. Attachment System Performance: Comply with ANSI/ASHRAE 90.1-2010 definition of continuous insulation (c.i.).
  2. No thermal bridges other than fasteners and service openings.
  3. Thermal Performance:
    - a. Full constructed assembly must have a minimum 95% EFFECTIVE R-value when compared to the exterior continuous insulations rated R-Value.
    - b. Continuous framing profiles (including C- or Z-shaped sections or furring) penetrating insulation not allowed.
    - c. Perform effective R-Value calculation or modeling in accordance with ASHRAE guidelines.
  4. Structural Performance:
    - a. Wind Load Performance - Attachment system must show the following results when tested in accordance with ASTM E330-02.
      - 1) 90 pound per square foot negative and positive pressure held for 60 seconds, system components shall not experience failure or gross permanent distortion.
      - 2) 135 pound per square foot negative and positive pressure held for 10 seconds, system components shall not experience failure or gross permanent distortion.
    - b. Wind cycling (air pressure cycling) performance - Attachment system must show conformance to the following results when tested in accordance with ASTM E1886-05.
      - 1) A total of 4,500 air pressure cycles. Cycles must include 50 cycles at a maximum pressure of 90 pounds both positive and negative. Average cycle time must not be less than 3.25 seconds for both negative and positive cycles. Cladding weight supported during test must be a minimum of 11.5 pounds per square foot. No damage or deformation must be seen at end of test.

- c. Gravity load (dead load) performance - Attachment system must demonstrate resistance to deflection under shear loading, applied parallel to the wall assembly and directly to the attachment system. Testing must be conducted using calibrated equipment by an IAS accredited third party laboratory. Deflection not to exceed 0.050 inches at 150 pounds per square foot.
5. Framing Members:
- a. Test framing components to AAMA TIR- A8-04 - Section 7.2 to determine structural performance and effective moment of inertia for each perforated component. Minimum Effective Moment of Inertia: 0.0066 in<sup>4</sup>.
  - b. Localized bending stress for eccentrically loaded framing members must be evaluated with the maximum effective length of resisting element not more than 12 inches.
6. Fasteners:
- a. Minimum Safety Factor of 3 for both tension and shear values
  - b. Combined tension and shear shall be evaluated according to an interaction formula. Sum of terms shall not exceed 1.0.

### 1.3 SUBMITTALS

- A. **Product Data:** Submit manufacturer's product literature and descriptions of testing performed on system components to indicate meeting or exceeding specified performance.
- B. **Shop Drawings:**
  1. Submit connection details to the cladding manufacturer, showing interface of rainscreen attachment system to substrate and panels with adjacent construction, signed and sealed by Professional Engineer.
  2. Show system installation and attachment, including fastener size and spacing.
- C. **Structural Calculations:**
  1. Submit rainscreen attachment manufacturer's comprehensive Structural Design analysis signed and sealed by a Professional Engineer.
- D. **Samples:** Submit following material samples for verification:
  1. Vertical Girts: Two (2) 12-inch long samples.
- E. **Test Reports:**
  1. Test to the following standards and provide written test reports by a third party:
    - a. AAMA TIR-A8- 04: Structural Performance of Composite Thermal Barrier Framing Systems - Section 7.2



- b. ASTM E330
  - c. ASTM E1233
  - d. Gravity load test report, performed by IAS accredited third party
2. Comprehensive three-dimensional thermal modeling report indicating framing systems impact on exterior insulation rated R-value.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
  1. Minimum 5 years' experience specializing in the manufacturing of façade attachment/support framing similar to those specified.
  2. Ability to demonstrate conformance to testing requirements.
- B. Installer Qualifications:
  1. Minimum of 3 years' documented experience or minimum of 5 completed projects of equivalent scope and quality and recommended by manufacturer to perform work of this Section.
  2. Onsite superintendent or foreman overseeing installation on site during entire work of this Section with experience equivalent to installer and in good standing with the manufacturer.
- C. Engineer Qualifications: Registered professional engineer experienced in the design of curtain wall systems, anchors, fasteners and licensed to practice engineering in the jurisdiction where Project is located.
- D. Pre-Installation Meeting:
  1. Discuss sequence and scheduling of work and interface with other trades.
  2. Review metal wall framing assemblies for potential interference and conflicts and coordinate layout and support provisions for interfacing work.
  3. Review and document methods, procedures and manufacturer's installation guidelines and safety procedures for exterior wall assembly.
- E. **Mock-Ups:** Coordinate mock-up materials and requirements with mock-up specified in Division 01 and exterior cladding specification.

#### 1.5 QUALITY CONTROL

- A. Single source responsibility:
  1. Furnish engineered rainscreen attachment system components under direct responsibility of single manufacturer.
- B. Field Measurements: Verify actual supporting and adjoining construction before fabrication.

- C. Record field measurements on project record shop drawings.
- D. Established Dimensions: Where field measurements cannot be made without delaying work, guarantee dimensions and proceed with fabrication of rainscreen attachment system corresponding to established dimensions.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Deliver materials and components in manufacturers' original, unopened and undamaged containers or bundles, fully identified. Exercise care to avoid damage during unloading, storing and installation.
- B. Store, protect and handle materials and components in accordance with manufacturer recommendations to prevent damage, contamination and deterioration. Keep materials clean, dry, and free of dirt and other foreign matter, and protect from damage due to weather or construction activities.

## 1.7 SEQUENCING

- A. Ordering: Comply with manufacturers' ordering instructions and lead time requirements to avoid construction delays.
- B. Coordinate construction to ensure that assemblies fit properly to supporting and adjoining construction; coordinate schedule with construction in progress to avoid delaying work.

## 1.8 WARRANTY

- A. Manufacturer Warranties:
  - 1. Attachment System: Ten (10) year Limited Warranty.
    - a. Covers components of the attachment system, including structural failure of components when all the materials and components are supplied and installed per manufacturer's requirements.
    - b. Includes labor and material for removal and replacement of defective material.
    - c. Includes labor to remove and reinstall façade finish panels, finish closures and façade finish accessories necessary to access defective material.
- B. Contractor's Warranties: 2-year labor warranty, starting from Substantial Completion, to cover repair of materials found to be defective as a result of installation errors.
- C. Limitation of Warranties: Exclude repairs, replacement, and corrective work to the substrate, primary structure, finish panels, and/or property - unless otherwise noted above. Warranties exclude mechanical damage due to abuse, neglect, primary structure failure, or forces of nature greater than normal weather conditions.

**1.9 MAINTENANCE**

- A. **Extra Materials:** For use by Owner in building maintenance and repair, provide 3 percent additional attachment components in new, unopened cartons, packaged with protective covering for storage and identified with appropriate labels.

**PART 2 - PRODUCTS**

**2.1 RIGID INSULATION**

- A. Refer to Section 07 21 00 - Thermal Insulation.

**2.2 WALL CLADDING ATTACHMENT/SUPPORT FRAMING SYSTEM**

- A. Comply with ANSI/ASHRAE 90.1-2010 definition of continuous insulation (c.i.).
- B. Coating Material: ASTM A1046, Zinc-Aluminum-Magnesium, minimum thickness ZM40.
1. ASTM A653 Galvanized steel is not acceptable.
- C. Steel Classification: Structural Steel (SS), Grade 50, 50 ksi Yield.
- D. Spacing: Comply with manufacturer's Professional Engineers calculations.
- E. Vertical Girt: Vertical girt with pre-punched attachment holes, directly attached on top of rigid insulation at regular spacing, with engineered thermally isolated washer assembly and fasteners.
1. Steel Thickness: Minimum 0.046-inch thick (18 gauge).
  2. Profile Depth: 0.75 inches.
  3. Girt Fastening Face, Width: 2-inches.
  4. Basis of Design: CI by Knight Wall Systems.
  5. Or approved equal.
- F. Fasteners:
1. Sufficient length to provide solid attachment through rigid insulation to structure as required by manufacturer.
  2. Thermal Isolating Washers: Minimum 0.125 inch thick Polyoxymethylene copolymer (POM) washers with integral centering lip to act as a thermal break between wall anchor fasteners and girt.
    - a. Tensile Yield Strength: 9.57 ksi per ISO 527
    - b. Melting Temperature: 329 degrees Fahrenheit per ISO 3146
    - c. Basis of Design: ThermaStop™ Isolator by Knight Wall Systems.

- d. Or approved equal.
- 3. Steel stud framing substrate: Self-drill hex-washer-head stainless steel with 1,000 hour salt-spray rated thermoset polyester coating.
  - a. Embedment depth: 0.625 inches or three full threads minimum, whichever is greater.
  - b. Minimum ultimate pull-out capacity from 18 gauge steel: 450 pounds.
- G. Accessories:
  - 1. Galvanic Protection: Utilize tapes and other methods as necessary to separate and prevent contact between dissimilar metals.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with manufacturer requirements for installation conditions affecting performance of the work.
  - 1. Do not proceed with installation until unsatisfactory conditions have been corrected.
  - 2. Ensure weather-resistant barrier (WRB) and rigid insulation is installed prior to installing rainscreen attachment system.
  - 3. Ensure fenestration, transitions, discontinuities, sills, and ledgers are flashed and sealed to move moisture to the exterior of the building.
- B. Field verify architectural details and mechanical and electrical requirements prior to commencing installation.
- C. Commencement of installation constitutes acceptance of existing conditions and acceptance of responsibility for satisfactory performance.

#### **3.2 CLADDING ATTACHMENT SYSTEM INSTALLATION**

- A. Preparation:
  - 1. Verify vertical girt does not cantilever past rigid insulation.
- B. Installation
  - 1. Install vertical girts in vertical orientation in strict accordance with manufacturer's installation instructions.
  - 2. Do not use shims to plumb the wall between the vertical girt and insulation.
  - 3. Minimum length of installed cut girt is 24-inches and shall be attached with at least two (2) fasteners.

4. Mount box girts, fastened up to 32 inches on center (as determined by the manufactures engineering calculations) over installed rigid insulation, using one wall anchor per pre-punched attachment hole at spacing indicated on engineering calculations.
  - a. Check plumb of vertical girts both parallel and perpendicular to the structure.
  - b. Tighten screws that attach vertical girt through insulation to substructure to a snug tight condition and not stripped. Do not over-torque beyond manufacturer's recommendation. If installed using hand tools, verify for each installer at beginning of project using snug-tight criteria. Do not use stripped holes.
  - c. Where obstructions are present and unavoidable (i.e. window openings), use laser or chalk line to restart girt.
  - d. Locate vertical girt at jamb conditions and outside corner conditions.
  - e. Use shearing instruments (i.e. snips, nibbler, etc.) for cutting metal framing components. Saws are not recommended, as the sparks produced during cutting will damage the anti-corrosion coating. If sparks are generated during cutting, be sure the portion of the component to be installed on the building is protected from sparks and that any stockpile near the cutting station is also protected.
  - f. The systems components should not be cut while installed on the building, unless using a shearing instrument.
  - g. Replace thermal isolator pieces that break during installation.
  - h. Provide a 3/8" - 1/2" gap between girts for expansion when multiple lengths of vertical girts are installed.
  
5. Attach secondary horizontal rails to vertical girts plumb, straight and square.
  - a. Tighten screws to a snug tight condition and not stripped. Do not use stripped holes or screws.
  - b. Shims can be used between horizontal rail and vertical girt or cladding panel and horizontal rail (if approved by cladding manufacturer). Shims cannot be used between vertical girt and insulation.
  - c. Both flanges/edges of stiffened horizontal rail must be attached to vertical girt.

**END OF SECTION**

## SECTION 07 25 00 - WEATHER BARRIERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

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

#### 1.2 ACTION SUBMITTALS

- A. **Product Data:** For each type of product.
- B. **Shop Drawings:** Show details of building paper at terminations, openings, and penetrations. Show details of flexible flashing applications.

#### 1.3 INFORMATIONAL SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 WATER-RESISTIVE BARRIER

- A. Building Paper: Water-vapor-permeable, asphalt-saturated kraft building paper that complies with ICC-ES AC38, Grade D; except with water-resistance rating not less than 1 hour.

#### 2.2 FLEXIBLE FLASHING

- A. Rubberized-Asphalt Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.040 inch.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Carlisle Coatings & Waterproofing Inc; CCW-705-TWF Thru-Wall Flashing.
    - b. Fiberweb, Clark Hammerbeam Corp.; Aquaflash 500.
    - c. Fortifiber Building Systems Group; Fortiflash 40.
    - d. Grace Construction Products; W.R. Grace & Co. -- Conn.; Vycor V40 Self-Adhered Flashing.
    - e. MFM Building Products Corp.; Window Wrap.

- f. Sandell Manufacturing Co., Inc; Presto-Seal.
- 2. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.
- B. Primer for Flexible Flashing: Product recommended in writing by flexible flashing manufacturer for substrate.

### **PART 3 - EXECUTION**

#### **3.1 WATER-RESISTIVE BARRIER INSTALLATION**

- A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.
- B. Cover sheathing with water-resistive barrier as follows:
  - 1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
  - 2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.
- C. Building Paper: Apply horizontally with a 2-inch overlap and a 6-inch end lap; fasten to sheathing with galvanized staples or roofing nails.

#### **3.2 FLEXIBLE FLASHING INSTALLATION**

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

### **END OF SECTION**

## SECTION 07 26 16 - UNDER-SLAB-ON-GRADE VAPOR RETARDER

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes vapor retarder and installation accessories for installation under concrete slabs on grade.
- B. Related Requirements:
  - 1. Section 03 30 00 "Cast-in-Place Concrete."
  - 2. Section 31 20 00 "Earth Moving" for preparation of subgrade below vapor retarder.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site two weeks before start of installation of reinforced vapor retarders.
  - 1. Review vapor-retarder installation, protection, and coordination with other work.

#### 1.3 ACTION SUBMITTALS

- A. **Product Data:** For each type of product indicated including installation instructions.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificate signed by manufacturer.
- B. Summary of test results per paragraph 9.3 of ASTM E 1745.
- C. Manufacturer's installation instructions for placement, seaming and penetration repair instructions.

#### 1.5 QUALITY ASSURANCE

- A. Provide vapor retarder and accessories from a single source and single manufacturer. Provide accessories manufactured or approved by vapor retarder manufacturer for application indicated.
- B. All mandatory ASTM E 1745 testing must be performed on a single production roll per ASTM E 1745 Section 8.1.



- C. Coordination: Schedule work such that membrane will not be left exposed to weather for longer than that recommended by the manufacturer.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in labeled packages. Store and handle in strict compliance with manufacturer's instructions. Protect from damage from weather, excessive temperature and construction operations. Remove and dispose of damaged material in accordance with applicable regulations.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Vapor retarder shall have all of the following qualities:
  - 1. Maintain permeance of less than 0.01 Perms grains/(ft<sup>2</sup> · hr · inHg) as tested in accordance with mandatory conditioning tests per ASTM E 1745 Section 7.1 (7.1.1-7.1.5).
  - 2. Other Performance Criteria:
    - a. Strength: ASTM E 1745 Class A.
    - b. Thickness: 15 mils minimum.

### 2.2 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fortifiber Building Systems Group; Moistop Ultra 15.
    - b. Grace Construction Products, W. R. Grace & Co.; Florprufe 120.
    - c. Reef Industries, Inc.; Griffolyn 15 mil Green.
    - d. Stego Industries, LLC; Stego Wrap 15 mil Class A.

### 2.3 ACCESSORIES

- A. Vapor Retarding Seam Tape:
  - 1. Water Vapor Transmission Rate: 0.3 perms or lower per ASTM E 96.
- B. Vapor Proofing Mastic:

1. Water Vapor Transmission Rate: 0.3 perms or lower per ASTM E 96.
- C. Pipe Boots: . Construct pipe boots from vapor barrier material, pressure sensitive tape and/or mastic per manufacturer's instructions.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Examine areas to receive vapor retarders. Notify Architect if areas are not acceptable. Do not begin installation until unacceptable conditions have been corrected.
- B. Ensure that subsoil is smooth, level and compacted with no sharp edges.
  1. Level and compact base material.
- C. Ensure that there is no moisture entrapment by vapor retarder due to rainfall or ground water intrusion.

#### **3.2 INSTALLATION**

- A. Install vapor retarder in accordance ASTM E 1643 and manufacturer's written instructions.
  1. Install vapor retarders continuously at locations under slab. Ensure there are no discontinuities in vapor retarder at seams or penetrations.
  2. Unroll vapor retarder with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.
  3. Extend vapor retarder over footings and grade beams to a distance acceptable to the structural engineer or stop at impediments such as dowels and waterstops.
  4. Seal vapor retarder to foundation wall, grade beam, or slab at an elevation consistent with the top of the slab or terminate at impediments such as waterstops or dowels.
  5. Overlap joints 6 inches and seal with manufacturer's tape.
  6. Apply tape to a clean and dry vapor barrier.
  7. Seal all penetrations with manufactured or field-fabricated boots and with tape according to manufacturer's guidelines. Unsealed penetrations are not allowed.
  8. Immediately repair damaged areas by cutting patches of vapor retarder, overlapping damaged area 6 inches and taping all sides with tape.

#### **3.3 PROTECTION**

- A. Protect vapor retarders from damage during installation of reinforcing steel and utilities and during placement of concrete slab.

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**END OF SECTION**

## SECTION 07 27 26 - FLUID-APPLIED MEMBRANE AIR BARRIERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Vapor-permeable, fluid-applied air barriers.

B. Related Requirements:

1. Section 06 16 00 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.
2. Section 07 25 00 "Weather Barriers" for weather barriers, including building paper.

#### 1.2 ACTION SUBMITTALS

A. **Product Data:** For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

#### 1.3 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

B. **Mockups:** Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly as indicated on Drawings, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
  - a. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### **1.4 FIELD CONDITIONS**

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
  1. Protect substrates from environmental conditions that affect air-barrier performance.
  2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

#### **2.2 PERFORMANCE REQUIREMENTS**

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 2357.

#### **2.3 HIGH-BUILD AIR BARRIERS, VAPOR PERMEABLE**

- A. High-Build, Vapor-Permeable Air Barrier: synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils or thicker over smooth, void-free substrates.
  1. Synthetic Polymer Type:
    - 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) Grace Construction Products; W.R. Grace & Co. -- Conn.; Perm-A-Barrier VPL.
  - 2) Henry Company, Sealants Division; Air-Bloc 33MR.
  - 3) Tremco Incorporated; ExoAir 230.
2. Physical and Performance Properties:
- a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
  - b. Vapor Permeance: Minimum 10 perms; ASTM E 96/E 96M, Desiccant Method, Procedure A.
  - c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.
  - d. Adhesion to Substrate: Minimum 16 lbf/sq. in. when tested according to ASTM D 4541.
  - e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
  - f. UV Resistance: Can be exposed to sunlight for 90 days according to manufacturer's written instructions.

## 2.4 ACCESSORY MATERIALS

- A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.
- B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.
- D. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
  1. 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; 123 Silicone Seal.
    - b. GE Construction Sealants; Momentive Performance Materials Inc.; US11000 UltraSpan.
    - c. Pecora Corporation; Sil-Span.
    - d. Tremco Incorporated; Spectrem Simple Seal.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
  - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
  - 2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 SURFACE PREPARATION**

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- E. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

### **3.3 ACCESSORIES INSTALLATION**

- A. Install accessory materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
  - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
  - 2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
  - 3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.

4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply preformed silicone extrusion so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.
  1. Transition Strip: Roll firmly to enhance adhesion.
  2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.
- F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- H. Seal top of through-wall flashings to air barrier with an additional 6-inch- wide, transition strip.
- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

### **3.4 PRIMARY AIR-BARRIER MATERIAL INSTALLATION**

- A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.
  1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.



2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
  3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.
- B. High-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.
1. Vapor-Permeable, High-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, but not less than 35 mils, applied in one or more equal coats.
- C. Do not cover air barrier until it has been tested and inspected by testing agency.
- D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

### **3.5 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 recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials 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 in writing by manufacturer of affected construction.
- C. Remove masking materials after installation.

### **END OF SECTION**

## SECTION 07 42 13.13 - FORMED METAL WALL PANELS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Concealed-fastener, lap-seam metal wall panels.

#### 1.2 ACTION SUBMITTALS

- A. **Product Data:** For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. **Shop Drawings:**
1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
  2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 3 inches per 12 inches.
- C. **Calculations:**
1. Include calculations with registered engineer seal, verifying wall panel and attachment method; resist wind pressures imposed on them pursuant to applicable building codes.
- D. **Samples for Initial Selection:** For each type of metal panel indicated with factory-applied finishes.
1. Include Samples of trim and accessories involving color selection.
- E. **Samples for Verification:** For each type of exposed finish, prepared on Samples of size indicated below:
1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. **Maintenance Data**: For metal panels to include in maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Manufacturer: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
  - 2. Installer: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Build mockup of typical metal panel assembly as indicated on Drawings, including corner, supports, attachments, and accessories.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Remove strippable protective covering on metal panels until installation. Remove as panels are installed. Verify that film is completely removed from installed panels.

## 1.7 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed in accordance with manufacturers' written instructions and warranty requirements.

## 1.8 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

## 1.9 WARRANTY

- A. **Special Galvalume Substrate Warranty:** Manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing or perforating.
    - b. Deterioration of metals and other materials beyond normal weathering.
  - 2. Warranty Period: **20 years and six months** from date of Substantial Completion.
- B. **Special Warranty on Panel Finishes:** Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested in accordance with ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
    - c. Cracking, chipping, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty **Period: 20 years** from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 29 percent.

- B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E1592:
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- C. Air Infiltration: Air leakage of not more than 0.01 cfm/sq. ft. when tested in accordance with ASTM E283 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- D. Water Penetration under Static Pressure: No water penetration when tested in accordance with ASTM E331 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 15 lbf/sq. ft.

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

- A. Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Wide-Reveal-Joint, Concealed-Fastener Metal Wall Panels : Formed with horizontal panel edges and a stepped profile between panel edges, resulting in a wide reveal joint between panels.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Berridge Manufacturing Co.; HR-16 or comparable product by one of the following:
    - a. CENTRIA Architectural Systems.
    - b. Morin; a Kingspan Group company.
  - 2. Metallic-Coated Steel Sheet: Aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
    - a. Nominal Thickness: 0.024 inch.
    - b. Surface: Smooth, flat finish.
    - c. Exterior Finish: Two-coat fluoropolymer.
    - d. Color: As selected by Architect from manufacturer's full range.
  - 3. Aluminum Sheet: Coil-coated sheet, ASTM B209, Alloy 3105, with H14 temper as required to suit forming operations and structural performance required.
    - a. Thickness: 0.032 inch.
    - b. Surface: Smooth, flat finish.
    - c. Exterior Finish: Two-coat fluoropolymer.

- d. Color: As selected by Architect from manufacturer's full range.
4. Panel Coverage: 16 inches.
5. Panel Height: 0.875 inch.

## 2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
  2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Zinc-coated steel, corrosion-resistant steel, zinc cast head, or nylon capped steel; type and size as approved for applicable loading requirements. Provide long-life exposed fasteners with heads matching color of metal panels by means of factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
  2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
  3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

## 2.4 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's written instructions and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application, but not less than thickness of metal being secured.

## 2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat applied by panel manufacturer on a continuous coil coating line, with a top side dry film thickness of 0.75 mil, plus or minus 0.05 mil, over 0.2 mil plus or minus 0.05-mil primer coat, to provide a total dry film thickness of 0.95 mil, plus or minus 0.10 mil. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.35 mil.

D. Aluminum Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat applied by panel manufacturer on a continuous coil coating line, with a top side dry film thickness of 0.75 mil, plus or minus 0.05 mil, over 0.2 mil plus or minus 0.05-mil primer coat, to provide a total dry film thickness of 0.95 mil, plus or minus 0.10 mil. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
  1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
  2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
    - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with ASTM C754 and metal panel manufacturer's written instructions.

### 3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels in accordance with manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Shim or otherwise plumb substrates receiving metal panels to be level to 1/4 inch in 20 ft..
  2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
  3. Install screw fasteners in predrilled holes.
  4. Locate and space fastenings in uniform vertical and horizontal alignment.
  5. Install flashing and trim as metal panel work proceeds.
  6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized steel fasteners for surfaces exposed to the interior.
  2. Aluminum Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use stainless steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended in writing by manufacturer.
1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
  2. Provide long-life metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
  3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.

4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
  5. Flash and seal panels with weather closures at perimeter of all openings.
- E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
  2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 ft. with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: 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 completed metal wall panel installation, including accessories.
- C. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.
- D. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- E. Prepare test and inspection reports.

### **3.5 CLEANING AND PROTECTION**

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

**END OF SECTION**

## SECTION 07 55 20 - MODIFIED BITUMINOUS MEMBRANE ROOFING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Providing labor, equipment, and miscellaneous materials to install Owner purchased and furnished roofing materials over properly prepared substrate.

B. Related Sections:

1. Section 06 10 53: Miscellaneous Carpentry
2. Section 07 21 00: Building Insulation
3. Section 07 62 00: Sheet Metal Flashing and Trim
4. Section 07 72 00: Roof Accessories

C. Related Requirements:

1. Project is under CMAS schedule (Contract No. **4-20-56-0006B**), where some products and materials will be furnished by Owner for installation by roofing installer (OFICI), and other products will be furnished and installed by roofing installer.
  - a. Products listed in Article **2.3** are to be supplied by Owner.
  - b. Other products to be provided by roofing installer.
2. Refer to District's Division 00 Documents, including General Conditions, and other Division 01 Sections, for additional requirements.

#### 1.2 REFERENCES

A. American Society of Civil Engineers (ASCE):

1. ASCE 7-10: Minimum Design Loads for Buildings and Other Structures.

B. ASTM International (ASTM):

1. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
2. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
3. ASTM D 451 - Standard Test Method for Sieve Analysis of Granular Mineral Surfacing for Asphalt Roofing Products.

4. ASTM D 1079 - Standard Terminology Relating, to Roofing, Waterproofing and Bituminous Materials.
  5. ASTM D 1227 - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.
  6. ASTM D 1863 - Standard Specification for Mineral Aggregate Used as a Protective Coating for Roofing.
  7. ASTM D 4586 - Standard Specification for Asphalt Roof Cement.
  8. ASTM D 2824 - Standard Specification for Aluminum-Pigmented Asphalt Roof Coating.
  9. ASTM D 5147 - Standard Test Method for Sampling and Testing Modified Bituminous Sheet Materials.
  10. ASTM D 6162 - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements.
  11. ASTM D 6163 - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements.
  12. ASTM E 108 - Standard Test Methods for Fire Test of Roof Coverings.
- C. Factory Mutual Global (FMG):
1. FM Approval 4435 - Approval Standard for Edge Systems Used with Low Slope Roofing Systems.
  2. FM Approval 4470 - Approval Standard for Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for use in Class 1 and Noncombustible Roof Deck Construction.
- D. National Roofing Contractors Association (NRCA):
1. NRCA Roofing Manual.
- E. UL, LLC (UL):
1. UL 790 - Standard for Standard Test Methods for Fire Tests of Roof Coverings.
- F. American National Standards Institute and Single Ply Roofing Institute (ANSI/SPRI):
1. ANSI/SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.
    - a. Testing and Certification Listing of Shop Fabricated Edge Metal and Coping.
    - b. Only required for fabricated item procedures.
- G. South Coast Air Quality Management District (SCAQMD):
1. SCAQMD Rule 1168 - Adhesive and Sealant Applications

### 1.3 QUALITY ASSURANCE

- A. Roofing Installer Qualifications: Roofing installer specializing in modified bituminous roof application with minimum 10 years experience.
1. Provide proof of certification to install manufacturer's roofing system within past three years.
  2. Provide letter from manufacturer at time of award of Contract, stating roofing installer is certified installer in good standing and approved to install roofing system.
  3. Issuance Date of Letter: Maximum fifteen days prior to Project bid date.
  4. Provide letter to Owner prior to award of Contract.
- B. Roofing Installer's Field Supervision: Require roofing installer to maintain full-time Supervisor/Foreman on Project Site during installation of bituminous membrane roofing work.
1. Maintain proper supervision of workmen while roofing work is in progress.
  2. Supervisor/Foremen shall be in possession of copy of roofing specification and be made available on roof.
- C. Contractor and roofing installer's responsibility to protect exposed buildings affected by roofing activities from possible weather damages, until completion of roofing work
- D. Disqualification of Bidders: Bidder may be disqualified by Owner for one or more reasons as indicated in Division 00 General Conditions.
- E. Roofing Pre-installation Meeting:
1. Before scheduled commencement of roof system installation and associated work, convene meeting at Project Site with installer of each component of associated Work:
    - a. Installer of deck or substrate construction to receive roofing work
    - b. Installer of rooftop units and other work where roofing must precede or follow roofing work, including mechanical work.
    - c. Owner and Architect.
    - d. Roofing system manufacturer's representative.
    - e. Other representatives directly concerned with performance of Work, including, where applicable, testing agencies and authorities having jurisdiction.
  2. Objectives to be reviewed include:
    - a. Requirements of CMAS schedule and coordination between Owner and roofing materials supplier as to products, materials, and quantities to be furnished by Owner and those to be furnished by roofing installer.
    - b. Foreseeable methods and procedures related to roofing work.
    - c. Tour representative areas of roofing substrates/decks.
      - 1) Inspect and discuss condition of substrate, roof drains, curbs, penetrations and other preparatory work performed by other trades.

- d. Structural loading limitations of deck and inspect deck for loss of flatness and for required attachment.
- e. Fire watch requirements of two hours at the end of each working day.
- f. Roofing system requirements as indicated in Drawings, Specifications, and other contract documents.
- g. Required submittals both completed and yet to be completed.
- h. Finalize construction schedule related to roofing work and verify availability of material.
  - 1) Ensure installer's personnel, equipment and facilities are sufficient to make progress and avoid delays.
- i. Required inspection, testing, certifying, and material usage accounting procedures.
- j. Weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary roofing.
  - 1) Notification procedures for weather or non-working days.
- k. Record discussion of meeting including decisions and agreements or disagreements reached and furnish copy of record to each party attending.
  - 1) Should substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

#### 1.4 SUBMITTALS

- A. Prepare and provide complete submittal package consisting of:
  - 1. Required documents such as, but not limited to installer's qualifications, Shop Drawings, and warranties.
    - a. Include submittals for Owner furnished materials.
    - b. Requests for substitutions are subject to review according to General Conditions.
    - c. Should substitution be approved, substitution material must conform to required Submittals.
- B. Product Data:
  - 1. Roofing system manufacturer's product data for products necessary for completion of roofing system and as specified including Owner Furnished Contractor Installed (OFCI) materials
    - a. Include roofing system manufacturer's technical product data, installation instructions, and recommendations for each type of roofing product required.
    - b. Include data substantiating that materials comply with minimum specified requirements.

- C. **Test Data and Certifications:**
1. Independent test data that indicates cap sheet complies with Cool Roof Rating Council (CRRC) and Title 24 Energy Standards requirements.
  2. Manufacturer's Certificate: Certified copy of roofing system manufacturer's ISO 9001 compliance certificate.
- D. **Installer Qualifications:**
1. Installer qualifications; refer to in "Quality Assurance" Article.
- E. Samples:
1. Samples of non-OFCI materials necessary for completion of roofing system.
- F. Warranty:
1. Unexecuted Manufacturer's Thirty Year High-Performance No Dollar Limit (NDL) warranty covering labor and materials
  2. Provide five years labor warranty to roofing system manufacturer and Owner.
- G. **LEED Submittals:**
1. Product Data for emittance, reflectance, and SRI values.
    - a. Documentation of compliance with requirements for reduction of heat island effect of specified materials
    - b. Product Certificates and Laboratory Test Reports.
  2. Recycled Content: Certify recycled content of specified roofing materials.
    - a. Indicate recycled content percent and whether pre-consumer or post-consumer.
    - b. Include statement indicating costs for each product having recycled content with manufacturer's receipts of proof of purchase.
    - c. Product Certificates and Laboratory Test Reports

## 1.5 SYSTEM DESCRIPTION

- A. Roof Deck:
1. Metal Deck:
    - a. Mechanically fasten R30 polyisocyanurate insulation to metal deck.
    - b. Mechanically fasten 1/2 inch Densdeckprime insulation roof coverboard complying with FM 1-90 wind uplift fastening pattern.
- B. Roofing Membrane Installation:



1. Apply 110 mil - *HPR Torchbase* -- SBS-modified base sheet with torch application.
2. Apply 195 mil - *Stressply IV Mineral* -- SBS-modified cap sheet with torch application.
3. Apply *HPR Torchbase* SBS-modified flashing ply with torch application in flashing areas extending 6 inches onto roof field. Apply additional *Stressply IV Mineral* modified flashing cap sheet with torch application in flashing areas extending 9 inches onto roof field.
4. Spray apply Title 24 Energy Standards compliant, *Pyramic Plus LO* reflective white, coating at 3 gallons/square.
  - a. Power wash roof surface prior to applying coating.
  - b. Ensure there is no moisture on roof surface prior to application of coating.
  - c. Apply the coating in two applications at 1.5 gal per sq each.
5. Edge metal, coping cap, and counterflashing metal to be installed by roofing contractor with ANSI SPRI ES-1 compliant *Rmer Flat Stock* sheet metal.
6. Install walkway pads leading to equipment from roof hatch.
7. Place conduit on rubber blocks and walkway pads.
8. Flash penetrations with umbrella storm cover.
  - a. Roofing contractor to supply and install lead flashings.
9. Roofing installer is responsible for ponding water and to ensure positive drainage.
10. Pitch pockets are not permitted.

## 1.6 PROJECT CONDITIONS

- A. Weather Condition Limitations: Do not apply roofing membrane during inclement weather or when 40 percent change of precipitation is expected.
- B. Do not apply roofing insulation or membrane to damp deck surface.
- C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.
- D. Proceed with roofing work only when existing and forecasted weather conditions will permit unit of work to be installed in accordance with manufacturer's recommendations and warranty requirements.
- E. Slopes greater than 2: 12 require back-nailing to prevent slippage of ply sheets.
  1. Use ring or spiral-shank one inch cap nails, or screws and plates at rate of one fastener per ply, including membrane, at each insulation stop.
  2. When slope exceeds 2:12, install plies parallel to slope to facilitate back nailing.
  3. Install four additional fasteners at upper edge of membrane when strapping plies.
- F. Application Conditions:

1. Take precautions when applying materials with spray equipment, to prevent over spray and solvents from damaging or defacing surrounding walls, building surfaces, vehicles or other property.
    - a. Exercise care to do following:
      - 1) Close air intakes into building.
    - b. Post and enforce "No Smoking" signs.
  2. Avoid inhaling spray mist.
    - a. Take precautions to ensure adequate ventilation.
  3. Protect completed roof sections from foot traffic for a period of at least 24 to 48 hours at 75 degrees F and 50 percent relative humidity, or until fully cured.
  4. Minimum temperature for application is 40 degrees F and rising.
- G. Maintain ABC-rated dry chemical fire extinguishers in locations per Cal/OSHA requirements
1. Make workers aware of locations and how to properly operate extinguishers.
  2. 2 hr fire watch by the installer is required at the end of each day.

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

- A. Roofing installer is responsible for coordinating OFCI material delivery by roofing materials supplier to Owner.
- B. Receive OFCI material at Project Site with seals and labels intact, in manufacturer's original containers, dry and undamaged.
  1. Damaged material to be noted at delivery and reported immediately to Owner and roofing system manufacturer.
- C. Roofing installer is responsible for materials upon delivery.
  1. Lost or stolen material must be replaced by roofing installer.
  2. Owner is absolved of liability in regards to material delivery or material storage.
  3. Owner may elect to not store material on their property and have roofing installer store material at third party insured storage area in accordance with requirements of Division 00 General Conditions.
- D. Store materials at room temperature until immediately prior to application.
  1. Discontinue application when material cannot be stored at temperature, which permits even distribution during application

- E. Store and handle roofing sheets in dry, well-ventilated, weather-tight place to ensure no possibility of significant moisture exposure.
  - 1. Store rolls of felt and other sheet materials on pallets or other raised surface.
  - 2. Stand roll materials on end.
  - 3. Cover roll goods with canvas tarpaulin or other breathable material
    - a. Do not use polyethylene.
- F. Do not leave unused materials on roof overnight or when roofing work is not in progress unless protected from weather and other moisture sources.
- G. Responsibility of roofing installer to secure material and equipment on Project Site.
  - 1. Should material or equipment be stored on roof, roofing installer must make sure that integrity of roof deck is not compromised.
  - 2. Damage to roof deck caused by roofing installer will be sole responsibility of roofing installer and will be repaired or replaced at his expense.

## 1.8 INSPECTION AND COORDINATION

- A. Comply with roofing inspector's requirements as provided by roofing system manufacturer.
  - 1. Is roofing installer's responsibility to keep roofing inspector, Project Inspector, Architect, and Owner informed regarding issues and concerns.

## 1.9 SEQUENCING AND SCHEDULING

- A. Roofing installer is responsible for coordinating material ordering and delivery with roofing system manufacturer and Owner (for OFCI materials) within Project Schedule.
- B. Sequence installation of modified bituminous sheet roofing with related units of work specified in other sections to ensure that roof assemblies, including roof accessories, flashing, trim, and joint sealants are protected against damage from effects of weather, corrosion and adjacent construction activity.
- C. Work must be fully completed on each day.
  - 1. Phased construction is not acceptable.
  - 2. Phased construction is defined as cap sheet not being applied over installed base sheet within same 12 hour workday.

## 1.10 **WARRANTY**

- A. Upon completion of Project, provide following:

1. Minimum **five year labor** warranty to Owner and roofing system manufacturer at no charge.
  2. Executed roofing system manufacturer **Thirty Year High-Performance** No Dollar Limit (NDL) warranty covering labor and materials.
- B. Roofing installer to submit minimum five-year warranty to roofing system manufacturer with copy directly to Owner.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Basis-of-Design: Design of roofing system is based upon roofing systems engineered and manufactured by The Garland Company, Cleveland, OH.
- B. Roofing installer is responsible for manufacturer's materials in excess of Owner purchased and furnished amount.
1. Owner to provide material quantities matching amounts listed in Article 2.03.
  2. Additional roofing system manufacturer's material required to complete Project is responsibility of roofing installer.
  3. Roofing contractor responsible for purchasing additional materials required, including freight and tax charges.
- C. Roofing installer to be present at delivery of Owner purchased roof materials.
1. Owner has no responsibility to provide equipment for handling or loading materials to roofing installer's trucks.
  2. Upon signature of delivery, roofing installer assumes full responsibility for Owner purchased roof materials.
  3. Replacement of materials lost or stolen are responsibility of roofing installer.
    - a. Roofing installer is responsible for freight and tax on replaced materials.

### **2.2 MEMBRANE MATERIALS**

- A. Modified Base Sheet:
1. HPR Torchbase, complying with ASTM D 6163 Type III Grade G
  2. Performance Characteristics:
    - a. Tensile Strength, ASTM D 5147: 2 in/min. at 73.4 ±3.6 degrees F MD 210 lbf/in XD 210 lbf/in
    - b. Tear Strength, ASTM D 5147: 2 in/min. at 73.4 ±3.6 degrees F MD 250 lbfXD 250 lbf

- c. Elongation at Maximum Tensile, ASTM D 5147: 2 in/min. @ 73.4 ±3.6°F MD 4.0 percentage XD 4.0 percentage

B. Modified Mineral Cap Sheet:

- 1. Stressply IV Mineral complying with ASTM D 6163 Type III Grade G
- 2. Performance Characteristics:
  - a. Tensile Strength, ASTM D 5147: 2 in/min. at 73.4 ±3.6 degrees F MD 210 lbf/in XD 210 lbf/in
  - b. Tear Strength, ASTM D 5147: 2 in/min. at 73.4 ±3.6 degrees F MD 250 lbf XD 250 lbf
  - c. Elongation at Maximum Tensile, ASTM D 5147: 2 in/min. at 73.4 ±3.6 degrees F MD 6.0 percentage XDD 6.0 percentage
  - d. Low Temperature Flexibility (ASTM D-5147) Passes -20 degrees F

C. White Coating: Pyramic Plus LO

- 1. Performance Characteristics:
  - a. Elongation 150%
  - b. SRI: 104

### 2.3 OWNER SUPPLIED MATERIALS

- A. Following quantities are maximum quantities established by roofing system manufacturer (The Garland Company) of OFCI materials which will be provided by Owner to roofing installer:
- B. Roofing installer, at his option, may make his own take-off of materials to verify these quantities.

<b>Product</b>	<b>Amount</b>	<b>Unit Size</b>
HPR Torch Base Sheet	<b>265</b>	Roll
Stressply IV Mineral	<b>347</b>	Roll
Pyramic Plus LO	<b>150</b>	5 Gal
KEE-Lock Mastic	<b>14</b>	5 Gal
Tuff Stuff Caulking	<b>50</b>	Tube
Garla Prime VOC	<b>1</b>	5 Gal
RMER SS Flat Stock	<b>61</b>	4' x 10'

## 2.4 ROOF INSULATION

- A. General: Provide preformed roof insulation boards complying with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.
  - 1. Provide polyisocyanurate board insulation.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches, unless otherwise indicated.
- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain.

## 2.5 INSULATION ACCESSORIES

- A. General: Furnish roofing insulation accessories recommended by insulation manufacturer for intended use and compatible with sheet roofing material.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions of FM 4470.
  - 1. Designed for fastening roofing insulation to substrate.
  - 2. Tested by manufacturer for required pullout strength
  - 3. Acceptable to roofing system manufacturer.
- C. Substrate Joint Tape: 6 or 8 inches wide, coated, glass-fiber joint tape
  - 1. Fabricate to slopes indicated.

## 2.6 GYPSUM FIBER ROOF BOARD

- A. Roof Board: ASTM C 1278, fiber-reinforced, homogenous composition, water-resistant gypsum substrate, 1/2 inch thick.
  - 1. Product: Subject to compliance with specified requirements, provide Securock Gypsum Fiber Roof Board by USG Corporation, or approved equal, subject to approval of roofing system manufacturer.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion resistance provisions in FMG 4470, designed for fastening roof board to roof deck.

## 2.7 RELATED MATERIALS

### A. Nails and Fasteners:

1. Non-ferrous metal or galvanized steel.
  - a. Hard copper nails shall be used with copper
  - b. Use aluminum or stainless steel nails with aluminum
  - c. Use stainless steel nails with stainless steel.
2. Fasteners: Self-clinching type of penetrating type as recommended by manufacturer of metal deck.
3. Nails and Fasteners: Flush-driven through flat metal discs of not less than one inch diameter.
  - a. Omit metal discs when one-piece composite nails or fasteners with heads not less than one inch diameter are used.

### B. Walkway Pads: Mineral-granule-surfaced, reinforced asphaltic composition, slip-resisting pads, manufactured as traffic pad for foot traffic and acceptable to roofing system manufacturer.

1. Pad Size: 36 inches by 36 inches, by 3/8 inch thick, minimum.
2. Walkway Pad Adhesive: Adhesive to adhere approved walkway pads.
  - a. As recommended and furnished by roofing system manufacturer.
  - b. Complying with SCAQMD Rule 1168.

### C. Sheet Metal Flashing:

1. Refer to materials and requirements specified in Section 07 62 00 for sheet metal flashing materials and installation.

### D. Butyl Tape: 100 percent solids, asbestos free, compressive tape designed to seal as recommended and furnished by membrane manufacturer.

1. Butyl tape is required at terminations.

### E. Sealant: *Tuff-Stuff MS True White*, moisture curing, single component polymer sealant, *as supplied by Owner*.

1. Comply with requirements of Section 07 92 00 and SCAQMD Rule 1168.

### F. Mastic: *Flashing Bond*

### G. GarMesh: 6 inch Mesh for three course application with mastic.

- H. Termination Bar: Provide a metal termination bar or approved top edge securement at the terminus of all flashing sheets at walls and curbs. Fasten the bar a minimum of 8 inches o/c to achieve constant compression. Provide suitable, sealant at the top edge if required.
- I. Fibrous Cant Strips: Provide non-combustible perlite or glass fiber cant strips at all wall/curb detail treatments where angle changes are greater than 45 degrees. Cant may be set in approved cold adhesives, hot asphalt or mechanically attached with approved plates and fasteners.
- J. Splash Blocks: Reinforced, precast concrete, of size, profile, and thickness shown on Drawings.
  - 1. Design Mix: 2 parts concrete sand, and 1 part cement.
    - a. Limit water content to make mix stiff.
  - 2. Cement: Portland Cement Type I or II gray, conforming to ASTM C 150.
  - 3. Course Aggregate: Carefully graded and washed gravel or stone conforming to ASTM C 33.
    - a. Mix gravel not to exceed 3/8 inch.
    - b. Gradation may vary to achieve desired finish and texture.
  - 4. Fine Aggregate: Carefully graded and washed natural concrete sand conforming to ASTM C 33.
    - a. Gradation may vary to achieve desired finish and texture.
- K. Water: Potable water free from impurities.
- L. Admixtures: When required, conforming to ASTM C 494.
- M. Reinforcing Steel: Conforming to ASTM 615, with deformations conforming to ASTM M 305.
  - a. M13 #4, Grade 60 rebar, and 1/4 inch HR round steel.
- N. Strength: Comprehensive strength of 4,000 to 6,000 psi at 28 days depending on mixture and additives, as determined by tests of 6 inch cylinders.
- O. Weight: 49 lbs.
- P. Color: Manufacturer's standard Gray.
- Q. Manufacturer: Modern Precast, Inc., Salt Lake City, UT, or approved equal.

## 2.8 LEED REQUIREMENTS:

- A. Credit SS - Heat Island Effect - Roof:
  - 1. Provide data for emittance, reflectance, and SRI value of roof coating.



- B. Credit MR - Recycled Materials:
  - 1. Provide percentage of recycled content, both post-consumer and pre-consumer.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrate surfaces to receive modified bitumen sheet roofing system and associated work and conditions under which roofing will be installed.
- B. Do not proceed with roofing until unsatisfactory conditions have been corrected in manner acceptable to roofing system manufacturer's representative, roofing installer, and Project Inspector.

#### **3.2 GENERAL INSTALLATION REQUIREMENTS**

- A. Cooperate with roofing system manufacturer's representative and inspection and testing agencies engaged or required to perform services in connection with installing roof system.
- B. Insurance/Code Compliance: Where required, install and test roofing system to comply with governing regulation and specified insurance requirements.
- C. Protect other work from spillage of roofing materials and prevent materials from entering or clogging drains and conductors.
  - 1. Replace or restore other work damaged by installations of modified bituminous roofing system Work.
- D. Coordinate installing roofing system components so that insulation and roofing plies are not exposed to precipitation or left exposed overnight.
- E. Cut-Offs: Provide cut-offs at end of each day's work to cover exposed ply sheets and insulation.
  - 1. Provide temporary covering of two plies of No. 15 organic roofing felt set in full mopping of bitumen with joints and edges sealed or other jointly agreed upon tie-in detail.
  - 2. Remove cut-offs immediately before resuming work.
- F. Substrate Joint Penetrations: Prevent bitumen from penetrating substrate joints, entering building, or damaging roofing system components.
- G. Apply roofing materials as specified herein unless recommended otherwise by roofing system manufacturer's instructions.

1. Keep roofing materials dry before and during application.
  2. Do not permit phased construction.
  3. Complete application of roofing plies, modified sheet and flashing in continuous operation.
  4. Begin and apply only as much roofing in one day as can be completed that same day.
- H. Keep ABC rated tire extinguisher in location per Cal/OSHA requirements
1. Make workers are aware of its location how to operate it properly.

### 3.3 APPLICATION PROCEDURE TORCH INSTALLATION

A. Underlayment Installation:

1. Lay out the roll in the course to be followed and unroll 6 feet.
2. Using a roofing torch, heat the surface of the coiled portion until the burn-off backer melts away. At this point, the material is hot enough to lay into the substrate. Progressively unroll the sheet while heating and press down with your foot to insure a proper bond.
3. After the major portion of the roll is bonded, re-roll the first 6 feet and bond it in a similar fashion.
4. Repeat this operation with subsequent rolls with side laps of 4 inches and end laps of 8 inches.
5. Give each lap a finishing touch by passing the torch along the joint and spreading the melted bitumen evenly with a rounded trowel to insure a smooth, tight seal.
6. Extend underlayment 2 inches beyond top edges of cants at wall and projection bases.
7. Install base flashing ply to all perimeter and projections details.

B. Modified Membrane Installation:

1. Using a roofing torch, heat the surface of the coiled portion until the burn-off backer melts away. At this point, the material is hot enough to lay into the substrate. Progressively unroll the sheet while heating and press down with your foot to insure a proper bond.
2. After the major portion of the roll is bonded, re-roll the first 6 feet and bond it in a similar fashion.
3. Repeat this operation with subsequent rolls with side laps of 4 inches and end laps of 8 inches.
4. Give each lap a finishing touch by passing the torch along the joint and spreading the melted bitumen evenly with a rounded trowel to insure a smooth, tight seal.

C. Flashing Membrane Application:

1. Mechanically fasten torch acceptable sheet or insulation board to all flashing curbs.
2. Torch apply modified flashing base to the underlying base flashing ply. Nail off at a minimum of 8 inches o.c. from the finished roof at all vertical surfaces.

3. Solidly adhere the entire sheet of flashing membrane to the substrate. Tops of all flashings that are not run up and over curb shall be secured through termination bar 6 inches and sealed at top
4. Seal all vertical laps of flashing membrane with a three-course application of trowel-grade mastic and fiberglass mesh.
5. Coordinate counter flashing, cap flashings, expansion joints, and similar work with modified bitumen roofing work.

D. Application of Surfacing:

1. Prior to installation of surface, obtain approval from coating manufacturer as to Work completed.
2. Water power wash roof prior to surfacing per coating manufacturer's product installation requirements.
  - a. All-purpose Industrial degreaser/cleaner:
    - 1) Simple Green , or approved equal.
3. Besides mastic, roof can be coated immediately upon approval of punch list items.
4. Cure Time: Allow roofing system proper time to cure prior to application of coating.
  - a. System will require 7 days of cure time.
  - b. Mastics will require 30 days of cure time.
5. Reflective Coating:
  - a. Pyramic Plus LO
    - 1) Coat roof field and flashing with Title 24 Energy Standard compliant, white coating at 3 gallon per square.

E. Scupper Through Wall (Overflow):

1. Inspect the nailer to assure proper attachment and configuration.
2. Run one ply over nailer up the overflow, into the scupper hole and up flashing as in typical wall flashing detail. Assure coverage of all wood nailers.
3. Install scupper box in a 1/4 inch bed of mastic. Assure all box seams are soldered and have a minimum 4 inch flange. Make sure all corners are closed and soldered. Prime scupper at a rate of 100 square feet per gallon and allow to dry.
4. Fasten flange of scupper box every 3 inches o.c. staggered.
5. Strip in flange scupper box with base flashing ply covering entire area with 6 inch overlap on to the field of the roof and wall flashing.
6. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches on to the field of the roof. Apply a three-course application of mastic and mesh at all seams.

F. Coping Cap:

1. Minimum flashing height is 8 inches above finished roof height. Maximum flashing height is 24 inches. Prime vertical wall at a rate of 100 square feet per gallon and allow to dry.
2. Set cant in bitumen. Run all field plies over cant a minimum of 2 inches.
3. Attach tapered board to top of wall.
4. Install base flashing ply covering entire wall and wrapped over top of wall and down face with 6 inches on to field of roof and set in cold asphalt. Nail membrane at 8 inches o.c.
5. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches on to the field of the roof. Apply a three-course application of mastic and mesh at all seams and allow to cure and aluminize.
6. Install continuous cleat and fasten at 6 inches o.c. to outside wall.
7. Install new metal coping cap hooked to continuous cleat.
8. Fasten inside cap 24 inches o.c. with approved fasteners and neoprene washers through slotted holes, which allow for expansion and contraction.

G. Roof Drain:

1. Plug drain to prevent debris from entering plumbing.
2. Taper insulation to drain minimum of 24 inches from center of drain.
3. Run roof system plies over drain. Cut out plies inside drain bowl.
4. Set lead/copper flashing (30 inch square minimum) in 1/4 inch bed of mastic. Run lead/copper into drain a minimum of 2 inches. Prime lead/copper at a rate of 100 square feet per gallon and allow to dry.
5. Install base flashing ply (40 inch square minimum) in bitumen.
6. Install modified membrane (48 inch square minimum) in bitumen.
7. Install clamping ring and assure that all plies are under the clamping ring.
8. Remove drain plug and install strainer.

H. Plumbing Stack:

1. Minimum stack height is 12 inches.
2. Run roof system over the entire surface of the roof. Seal the base of the stack with elastomeric sealant.
3. Prime flange of new sleeve. Install properly sized sleeves set in 1/4 inch bed of roof cement.
4. Install base flashing ply in bitumen.
5. Install membrane in bitumen.
6. Caulk the intersection of the membrane with elastomeric sealant.
7. Turn sleeve a minimum of 1 inch down inside of stack.

I. Heat Stack:

1. Minimum stack height is 12 inches.
2. Run roof system over the entire surface of the roof. Seal the base of the stack with elastomeric sealant.
3. Prime flange of new sleeve. Install properly sized sleeves set in 1/4 inch bed of roof cement.
4. Install base flashing ply in bitumen.

5. Install modified membrane in bitumen.
6. Caulk the intersection of the membrane with elastomeric sealant.
7. Install new collar over cape. Weld collar or install stainless steel draw brand.

### 3.4 SHEET METAL FLASHING AND TRIM INSTALLATION

- A. Comply with requirements of Section 07 62 00 for flashing materials and installation requirements and as follows:
  1. Prefabricated, prefinished sheet metal for coping cap, counter flashing, edge metal, and skirt flashing details, except where stainless steel is indicated.
  2. Fascia Cover: Tie into edge metal and lap over end of fascia board at 2 inches minimum.
  3. Gutters: Where indicated.
  4. Stainless steel flashings at penetration points.
    - a. Umbrella cover for stainless steel flashings.
- B. Crickets: Install cricket on high side of mechanical units.
  1. Roofing installer is responsible for positive drainage of water.
- C. Terminate flashing with termination bar set in butyl tape on HVAC units / curbs. 1.  
Install 22 gauge, galvanized, coil coated metal counterflashing.
- D. Place new and existing conduit on redwood blocks and walkway pads.
- E. Seal equipment with specified Title 24 coating.
  1. Apply at 2 gallons per square.
- F. Seal duct work seams and corners with three course application of Flashing Bond and Mesh.
- G. Splash Blocks: Install splash blocks in locations shown on Drawings.

### 3.5 FIELD QUALITY CONTROL

- A. Require attendance of roofing system manufacturer's representatives at Project Site during installation of roofing system.
  1. Roofing system manufacturer's roofing inspector is required to sign off on roofing scope of work indicated in Article 1.5 B.
- B. Roofing System Manufacture's Responsibilities:
  1. While roofing work is in progress, roofing system manufacturer will provide inspections in accordance with following:

- a. Perform Project Site inspections for minimum of four days per week.
- b. Keep Owner and Architect informed as to progress and quality of Work as observed.
- c. Report to Owner and Architect, in writing, failure or refusal of roofing installer to correct unacceptable practices called to roofing installer's attention.

C. Roofing Installer's Responsibilities:

1. Comply with requirements of Roofing Inspector provided by roofing system manufacturer.
2. Keep Roofing Inspector, Project Inspector, Architect, and Owner informed regarding issues and concerns.
3. Confirm after completion that manufacturer has observed no application procedures in conflict with specifications other than those that may have been previously reported and corrected.

### 3.6 FINAL INSPECTION

- A. At completion of roofing installation and associated work, meet with roofing installer, installer of associated work, Owner, Architect, roofing system manufacturer's representative, and other representatives directly concerned with performance of roofing system.
- B. Inspect roof surface areas of building, including perimeter building edges, flashing of roof penetrations, walls, curbs and other equipment.
  1. List items requiring correction or completion and furnish copy of list to each parting attending.
- C. Owner reserves right to request thermographic scan of roof during final inspection to determine if damp or wet materials have been installed.
  1. Should defects be discovered, roofing installer shall correct and fix defective areas at no charge to Owner.
- D. Should core cuts verify presence of damp or wet materials, roofing installer shall be required to replace damaged areas at his own expense.
- E. Repair or replace, as required, deteriorated or defective work found at time above inspection, to condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- F. Roofing installer is to notify Owner upon completion of corrections.
- G. Following final inspection, acceptance will be made in writing by roofing system manufacturer.

1. Roofing installer shall provide needed coordination for providing such approval.
- H. Comply with specified closeout procedures in Section 01 77 00.

### **3.7 CLEANING**

- A. Remove drippage of bitumen from walls, windows, floors, ladders and finished surfaces.
- B. In areas where finished surfaces are soiled by asphalt or other sources of soiling caused by roofing work, consult manufacturer of surfaces for cleaning advice and conform to their instructions.
- C. Roofing installer is not to use Owner's rubbish bins.
  1. Remove used material containers and dispose of off Project Site.
  2. Comply with requirements of Section 01 74 19.

**END OF SECTION**

## SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Formed low-slope roof flashing and trim.
  2. Formed wall flashing and trim.
  3. Formed equipment support flashing.
  4. Formed overhead-piping safety pans.
- B. Single Subcontract Responsibility: Refer to roofing sections for the requirements of single subcontract responsibilities for sheet metal flashing and trim.

#### 1.2 ACTION SUBMITTALS

- A. **Product Data:** Submit product data for each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. **CALgreen Submittals:**
1. Product Data for Section 5.504.4.1.1: For sealants, adhesives and caulks, provide documentation including printed statement of VOC content showing compliance with SCAQMD Rule 1168 VOC limits and CCR (California Code of Regulations) Title 17 for aerosols.
  2. Product Data for Section 5.504.4.1.2: Provide documentation for aerosol adhesives, and smaller unit sizes of adhesives, sealant, and caulking compounds (in units of product, less packaging, which do not weigh more than one (1) pound and do not consist of more than sixteen (16) fluid ounces) comply with statewide VOC standards and prohibitions on use of certain toxic compounds, of CCR Title 17, commencing with Section 94507.
  3. Product Data for Section 5.504.4.3: For architectural paints and coatings, provide documentation including printed statement of VOC content showing compliance with Table 1 of the ARB, Architectural Coatings Suggested Control Measure, unless more stringent local limits apply.
  4. Product Data for Section 5.504.4.3.1: Aerosol paints and coatings, provide documentation that products meet the PWMIR Limits for ROC in Section 94522 (a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Section 94522(c)(2) and (d)(2) of CCR Title 17.
- C. **Shop Drawings:** Submit shop drawings showing layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:
1. Identify material, thickness, weight, and finish for each item and location in Project.



2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
  3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.
  4. Details of expansion-joint covers, including showing direction of expansion and contraction.
- D. **Samples:** Submit 8 inches x 8 inches (200 x 200 mm) square samples of sheet metal flashing, in the specified finish.

### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Subcontract the sheet metal flashing and trim work to a firm which is specialized in the fabrication and installation of sheet metal flashing and trim and who has successfully installed work similar in design and extent to that required for the project, in not less than three projects of similar scope to the satisfaction of the Architect, and whose work has resulted in construction with a record of successful in-service performance for a period of 5 years. .
- B. Sheet Metal Flashing and Trim Reference Standards: Comply with the industry standard sources below. Where sheet metal flashing and trim work details have not been specifically detailed on the drawings or specified the Contractor shall submit, for the Architect's approval, proposed sheet metal detailing. The primary source for proposed sheet metal detailing shall come from the industry standard sources below.
1. SMACNA's Architectural Sheet Metal Manual.
  2. NRCA's Roofing and Waterproofing Manual.
  3. ANSI/SPRI ES-1 Wind Design Standard for Edge Systems Used with Low Slope Roof Systems except where the Performance Requirements are more stringent.
- C. Sealant Compatibility and Adhesion Testing: Use sealant manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
- D. Design Modifications: Submit design modifications necessary to meet the performance requirements and field coordination. Variations in details or materials which do not adversely affect the appearance, durability or strength of components shall be submitted to the Architect for review. Maintain the general design concept without altering size of members, profiles and alignment.

### 1.4 COORDINATION

- A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

## **1.5 WARRANTY**

- A. Furnish written warranty against water leakage resulting from defects of materials or workmanship. Upon notification of such defects, within the warranty period, make the necessary repairs and replacements at the convenience of, and no cost to, the Owner. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.
1. Warranty period shall be 5 years after the date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Fabricate and install exterior wall and roofing sheet metal flashing and trim capable of resisting the wind forces greater than or equal to those shown on Structural Drawings for components and cladding.
- C. SPRI Wind Design Standard: Manufacture and install copings tested according to SPRI ES-1 and capable of resisting the following design pressure:
1. Design Pressure: As indicated on Drawings.
- D. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from surface temperatures ranging from +10 degrees F. to +180 degrees F., without buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements.
1. Dimensions shown on Drawings are based on an assumed design temperature of +70oF. Fabrication and installation procedures shall take into account the ambient temperature range at the time of the respective operations.
- E. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

### **2.2 SHEET METALS**

- A. Aluminum Sheet: ASTM B 209, Alloy 3003, 3004, 3105, or 5005, Temper suitable for forming and structural performance required, but not less than H14, finished as follows:

1. High-Performance Organic Finish: Three-coat, thermocured system containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2604.
  - a. Color: Match Architect's samples.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M, soft annealed, Type 304, No. 2D finish, except where harder temper is required for forming or performance.
- C. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality, mill phosphatized for field painting.
- D. Prepainted, Metallic-Coated Steel Sheet: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
  1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
  2. Exposed Finishes: Apply the following coil coating:
    - a. High-Performance Organic Finish: Three-coat thermocured system containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with physical properties and coating performance requirements of AAMA 2604, except as modified for below:
      - 1) Humidity and Salt Spray Resistance: 2000 hours.
      - 2) Color: Match Architect's samples.
- E. Lead Sheet: ASTM B 749, Type L51121, copper-bearing lead sheet.

### 2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.
- B. Underlayment: Self-Adhering, High-Temperature Sheet: 0.76 mm thick, self adhering, self sealing, underlayment consisting of slip-resisting high density cross laminated polyethylene-film top surface laminated to layer of butyl rubber based adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
  1. Thermal Stability: Stable after testing at 116 deg C ; ASTM D 1970.
  2. Product Reference: Grace, W. R. & Co.; Ultra.
- C. Fasteners: Wood screws, same metal as flashing/sheet metal, annular threaded nails, self-tapping screws, and other suitable fasteners designed to withstand design loads.
- D. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer, use a noncorrosive rosin flux over tinned surfaces.

- E. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
- F. Elastomeric Sealant: ASTM C 920 and Section 07 92 00 "Joint Sealants," 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. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.
- H. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound.
- I. Bituminous Coating: Cold-applied bituminous paint complying with ASTM D 1187, compounded for 15 mil dry film thickness per coat.
- J. Wood Nailer Strips: Provide wood nailer strips, fabricated to sizes indicated, from lumber complying with the requirements of Section 06 10 53 "Miscellaneous Rough Carpentry" and fire retardant treated by pressure process using chemical solution which is non-hygroscopic and non-corrosive to sheet metal used.
- K. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional regulations as referenced in Section 01 81 23 "CALgreen Requirements."
- L. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds shall comply with regulations as referenced in Section 01 81 23 "CALgreen Requirements."
- M. Architectural paints and coatings shall comply with VOC limits as defined by local, regional, or state regulations as referenced in Section 01 81 23 "CALgreen Requirements."
- N. Aerosol paints and coatings shall meet the Product-weighted MIR Limits for ROC as referenced in Section 01 81 23 "CALgreen Requirements."

## 2.4 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with the referenced standards that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.
- B. Fabricate sheet metal flashing and trim in thickness needed to comply with performance requirements, but not less than that specified for each application and metal.
- C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
- F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- G. Fabricate cleats and attachment devices from same material as accessory being anchored. Cleats shall be 2 inches wide by nominal 3 inches long typically, minimum 0.0187 inch thick, punch for minimum 2 nail or screw holes. One end shall be locked into seams, or into folded edge of sheet metal sheets, the other end shall be secured with nails or screws and folded back over nail or screw heads.

## 2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Copings: Fabricate in minimum 96 inches long, but not exceeding 10 foot long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder watertight.
1. Joint Style: Butt, with 6-inch- wide exposed cover plates.
  2. Fabricate copings from the following material:
    - a. Aluminum: 0.050 inch thick.
- B. Base Flashing: Fabricate from the following material:
1. Galvanized Steel: 0.0276 inch thick.
- C. Counterflashing and Flashing Receivers: Fabricate from the following material:
1. Galvanized Steel: 0.0217 inch thick.
- D. Roof-Penetration Flashing: Fabricate from the following material:
1. Lead: 4.0 lbs./sq. ft. thick, hard tempered.
- E. Roof-Drain Flashing: Fabricate from the following material:

1. Lead: 4.0 lbs./sq. ft. thick, hard tempered.

## **2.6 WALL SHEET METAL FABRICATIONS**

- A. Openings Flashing in Frame Construction: Fabricate through wall head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high end dams. Fabricate from the following material:

1. Galvanized Steel: 0.0217 inch thick.

## **2.7 MISCELLANEOUS SHEET METAL FABRICATIONS**

- A. Equipment Support Flashing: Fabricate from the following material:

1. Galvanized Steel: 0.0276 inch thick.

- B. Overhead-Piping Safety Pans: Fabricate from the following material:

1. Galvanized Steel: 0.0396 inch thick.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.
  1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
  2. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION, GENERAL**

- 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. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Nailer and Underlayment Installation for Copings:

1. Provide wood nailers shown to properly install the coping. Form to shapes indicated and cut as required for true line and level of attached work. Set to required levels and lines. Allow approximately 1/8" between nailer ends and offset joints a minimum of 12" in multiple layers. Locate nailers to comply with requirements for attaching other construction.
  2. Utilize mechanical fasteners that will have no detrimental effect on the components of the coping. Recess fasteners flush with surfaces. Fasten in accordance with FM 1-49 standards and the coping manufacturers recommendations.
  3. Underlayment Installation: Install a course of self adhering high temperature sheet underlayment directly over nailers in accordance with the underlayment manufacturers instructions to the extent indicated on the drawings. Lap ends of underlayment lengths a minimum of 4 inches.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
1. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of underlayment.
  2. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.
- D. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
- E. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, and butyl sealant.
- F. 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.
1. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
- G. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
- H. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
1. Galvanized or Prepainted, Metallic-Coated Steel: Use stainless-steel fasteners.
  2. Aluminum: Use aluminum or stainless-steel fasteners.
  3. Stainless Steel: Use stainless-steel fasteners.
- I. Seal joints with butyl sealant as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant.
- J. Soldered Joints: Edges of sheets to be soldered shall be in close contact at every point along the joint before soldering. Edges of all sheets of sheet metal to be soldered shall be tinned with solder on both sides for a minimum width of 1-1/2 inches. Where specified, all seams shall be thoroughly soldered to produce watertight joints. All soldering shall be done slowly with well heated metal - to heat sheet thoroughly and to sweat solder completely through full width of seam. Ample solder shall be used and seam shall show at least one full inch of evenly flowed solder. Wherever possible all soldering shall be done in flat position. Remove every trace of flux residue from metal promptly after tinning. Comply with manufacturer's recommended methods for cleaning and neutralization. Clean exposed surfaces of sheet metal flashing and trim of every substance which is visible or might cause corrosion of metal surfaces. Use soldering irons (3 lb. Minimum each). Do not use abrasives in preparing the sheet metal surfaces for soldering. All exposed parts of finished soldered joints shall be smooth and free of smeared solder.
1. Do not solder prepainted, metallic-coated steel and aluminum sheet.
  2. Pretinning is not required for lead.

### 3.3 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal roof flashing and trim to comply with performance requirements and the referenced standards. Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.
- B. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49.
1. Interlock exterior bottom edge of coping with continuous cleats anchored to substrate at 16 inch centers.
  2. Anchor interior leg of coping with screw fasteners and washers at 18 inch centers.
- C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Secure in a waterproof manner. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with butyl sealant.
- E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:
1. Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.



2. Seal with butyl sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.

### **3.4 WALL FLASHING INSTALLATION**

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Openings Flashing in Frame Construction: Install continuous through wall head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

### **3.5 MISCELLANEOUS SHEET METAL FABRICATION INSTALLATION**

- A. Overhead-Piping Safety Pans: Suspend pans from pipe and install drain line to plumbing waste or drain line.
- B. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Seal flashing with elastomeric sealant to equipment support member.

### **3.6 CLEANING AND PROTECTION**

- A. Clean exposed metal surfaces for uniform oxidation and weather exposure; neutralize flux materials; clean off excess solder and sealants; and remove strippable films, if any.
- B. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, and pieces of flashing. Maintain in a clean condition during construction.
- C. 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.

### **END OF SECTION**

## SECTION 07 72 00 - ROOF ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Roof curbs.
2. Equipment supports.
3. Roof hatches.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
2. Section 07 62 00 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
3. Section 23 05 48 "Vibration and Seismic Controls for HVAC" for special curbs designed to accommodate seismic and vibration controls.
4. Section 23 34 23 "HVAC Power Ventilators" for power roof-mounted ventilators.
5. Section 23 74 13 "Packaged, Outdoor, Central-Station Air-Handling Units" for standard curbs specified with rooftop units.

#### 1.2 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

#### 1.3 ACTION SUBMITTALS

- A. **Product Data:** For each type of roof accessory.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. **Shop Drawings:** For roof accessories.

1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.
- C. **Samples:** For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
  1. Size and location of roof accessories specified in this Section.
  2. Method of attaching roof accessories to roof or building structure.
  3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
  4. Required clearances.
- B. Sample Warranties: For manufacturer's special warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- A. **Operation and Maintenance Data:** For roof accessories to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Wind-Restraint Performance: As indicated on Drawings.

#### 2.2 ROOF CURBS

- A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AES Industries, Inc.
  - b. Curbs Plus, Inc.
  - c. Custom Solution Roof and Metal Products.
  - d. Greenheck Fan Corporation.
  - e. Kingspan Light + Air, North America.
  - f. Lloyd Industries, Inc.
  - g. LMCurbs.
  - h. Milcor; Commercial Products Group of Hart & Cooley, Inc.
  - i. Pate Company (The).
  - j. Plenums Incorporated.
  - k. Roof Curb Systems.
  - l. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.
  - m. Thybar Corporation.
  
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
  
- C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.
  
- D. Material: Zinc-coated (galvanized) steel sheet, 0.064 inch thick.
  1. Finish: Factory prime coating.
  
- E. Construction:
  1. Curb Profile: Manufacturer's standard compatible with roofing system.
  2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
  3. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
  4. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange or by use of leveler frame.
  5. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
  6. Insulation: Factory insulated with 1-1/2-inch- thick glass-fiber board insulation.
  7. Liner: Same material as curb, of manufacturer's standard thickness and finish.
  8. Nailer: Factory-installed wood nailer along top flange of curb under top flange on side of curb, continuous around curb perimeter.
  9. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
  10. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch- thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.

11. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.
12. Security Grille: Provide where indicated.

### 2.3 EQUIPMENT SUPPORTS

- A. Equipment Supports: Rail-type metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, integral metal cant, and integrally formed structure-mounting flange at bottom.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Curbs Plus, Inc.
    - b. Greenheck Fan Corporation.
    - c. LMCurbs.
    - d. Milcor; Commercial Products Group of Hart & Cooley, Inc.
    - e. Plenums Incorporated.
    - f. Roof Curb Systems.
    - g. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.
    - h. Thybar Corporation.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.
- D. Material: Aluminum-zinc alloy-coated steel sheet, 0.064 inch thick.
  1. Finish: Factory prime coating.
- E. Construction:
  1. Curb Profile: Manufacturer's standard compatible with roofing system.
  2. Insulation: Factory insulated with 1-1/2-inch- thick glass-fiber board insulation.
  3. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
  4. Nailer: Factory-installed continuous wood nailers 3-1/2 inches wide on top flange of equipment supports, continuous around support perimeter.
  5. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to meet wind uplift requirements.
  6. Platform Cap: Where portion of equipment support is not covered by equipment, provide weathertight platform cap formed from 3/4-inch- thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.

7. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
8. Fabricate equipment supports to minimum height of 12 inches above roofing surface unless otherwise indicated.
9. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.

## 2.4 ROOF HATCHES

- A. Roof Hatches: Metal roof-hatch units with lids and insulated single-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.
  1. Basis of Design Product: Subject to compliance with requirements, provide Bilco Type S, or a comparable product by one of the following:
    - a. Acudor Products, Inc.
    - b. Architectural Specialties, Inc.
    - c. Babcock-Davis.
    - d. Dur-Red Products.
    - e. JL Industries, Inc.; a division of the Activar Construction Products Group.
    - f. Milcor; Commercial Products Group of Hart & Cooley, Inc.
    - g. Nystrom, Inc.
    - h. O'Keeffe's Inc.
    - i. Pate Company (The).
- B. Type and Size: Single-leaf lid, 30 by 36 inches.
- C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.
- D. Hatch Material: Zinc-coated (galvanized) steel sheet.
  1. Thickness: Manufacturer's standard thickness for hatch size indicated.
  2. Finish: Factory prime coating.
- E. Construction:
  1. Insulation: 1-inch- thick, glass-fiber board.
    - a. R-Value: 4.3 according to ASTM C1363.
  2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
  3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
  4. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.

5. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
  6. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.
- F. Hardware: Spring operators, hold-open arm, stainless steel spring latch with turn handles, stainless steel butt- or pintle-type hinge system, and padlock hasps inside and outside.
1. Provide two-point latch on lids larger than 84 inches.
  2. Provide remote-control operation.
- G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
1. Height: 42 inches above finished roof deck.
  2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches in diameter or galvanized-steel tube, 1-5/8 inches in diameter.
  3. Flat Bar: Galvanized steel, 2 inches high by 3/8 inch thick.
  4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches in diameter.
  5. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
  6. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
  7. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
  8. Fabricate joints exposed to weather to be watertight.
  9. Fasteners: Manufacturer's standard, finished to match railing system.
  10. Finish: Manufacturer's standard.
    - a. Color: As selected by Architect from manufacturer's full range.
- H. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
  2. Height: 42 inches above finished roof deck.
  3. Material: Steel tube.
  4. Post: 1-5/8-inch- diameter pipe.
  5. Finish: Manufacturer's standard baked enamel or powder coat.
    - a. Color: As selected by Architect from manufacturer's full range.

## 2.5 METAL MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 coating designation and mill phosphatized for field painting where indicated.
  - 1. Mill-Phosphatized Finish: Manufacturer's standard for field painting.
  - 2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil.
- B. Steel Shapes: ASTM A36/A36M, hot-dip galvanized according to ASTM A123/A123M unless otherwise indicated.
- C. Steel Tube: ASTM A500/A500M, round tube.
- D. Galvanized-Steel Tube: ASTM A500/A500M, round tube, hot-dip galvanized according to ASTM A123/A123M.
- E. Steel Pipe: ASTM A53/A53M, galvanized.

## 2.6 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Glass-Fiber Board Insulation: ASTM C726, nominal density of 3 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F, thickness as indicated.
- C. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.
- D. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWWA C2; not less than 1-1/2 inches thick.
- E. Security Grilles: 3/4-inch diameter, ASTM A1011/A1011M steel bars spaced 6 inches o.c. in one direction and o.c. in the other; factory finished as follows:
  - 1. Surface Preparation: Remove mill scale and rust, if any, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
  - 2. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment.
  - 3. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, lead- and chromate-free, universal primer; selected for resistance to normal atmospheric corrosion, for compatibility with substrate and field-applied finish paint system indicated, and for capability to provide a sound foundation for field-applied topcoats under prolonged exposure.



- F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- G. Underlayment:
  - 1. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils 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.
- H. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
  - 1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.
- I. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- J. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
- K. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.
- L. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
  2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
  3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
  4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Roof Curb Installation: Install each roof curb so top surface is level.
- C. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.
- D. Roof-Hatch Installation:
1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
  2. Attach safety railing system to roof-hatch curb.
  3. Attach ladder-assist post according to manufacturer's written instructions.
- E. Security Grilles: Weld bar intersections and, using tamper-resistant bolts, attach the ends of bars to structural frame or primary curb walls.
- F. Seal joints with elastomeric butyl sealant as required by roof accessory manufacturer.

### **3.3 REPAIR AND CLEANING**

- A. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 09 91 13 "Exterior Painting."
- B. Clean exposed surfaces according to manufacturer's written instructions.
- C. Clean off excess sealants.
- D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

**END OF SECTION**

## SECTION 07 84 13 - PENETRATION FIRESTOPPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes through-penetration firestop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:
1. Floors.
  2. Roofs.
  3. Walls and partitions.
  4. Smoke barriers.

#### 1.2 ACTION SUBMITTALS

- A. **Product Data:** Submit product data for each type of through penetration firestop system product indicated.
- B. **CALgreen Submittals:**
1. Product Data for Section 5.504.4.1: For sealants, adhesives and caulks, provide documentation including printed statement of VOC content showing compliance with SCAQMD Rule 1168 VOC limits and CCR (California Code of Regulations) Title 17 for aerosols.
  2. Product Data for Section 5.504.4.1.2: Provide documentation for aerosol adhesives, and smaller unit sizes of adhesives, sealant, and caulking compounds (in units of product, less packaging, which do not weigh more than one (1) pound and do not consist of more than sixteen (16) fluid ounces) comply with statewide VOC standards and prohibitions on use of certain toxic compounds, of CCR Title 17, commencing with Section 94507.
- C. **Through-Penetration Firestopping Schedule:** Submit a Through-Penetration Firestopping Schedule indicating the type of through-penetration firestop system to be installed for each penetration. Indicate each kind of construction condition penetrated and kind of penetrating item. Include firestop design designation of testing and inspection agency acceptable to the authorities having jurisdiction that evidences compliance with requirements for each condition indicated.
1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

- a. Engineering judgment shall include both project name and contractor's name who will install firestop system as described in document

### **1.3 INFORMATIONAL SUBMITTALS**

- A. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.

### **1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: A firm or individual certified or licensed, by firestop system manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its firestop system materials to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.
  1. The installer must have no less than 3 years of experience with fire stop installation.
- B. Installer Qualifications: A firm that has been approved by FM Approval according to FM Approval 4991, "Approval Standard for Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
  1. The installer must have no less than 3 years of experience with fire stop installation.
- C. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multi-component materials.
- B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

### **1.6 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet.

- B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

## **1.7 COORDINATION**

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.
- C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.
- D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Architect, Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Test-Response Characteristics:
  - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
  - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
    - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
      - 1) UL in its "Fire Resistance Directory."
      - 2) Intertek Group in its "Directory of Listed Building Products."
      - 3) FM Approval in its "Approval Guide."

### **2.2 PENETRATION FIRESTOPPING SYSTEMS**

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
  2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
  3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.
1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
1. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional regulations as identified in CALgreen Section 5.504.4.
  2. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds shall comply with regulations as identified in CALgreen Section 5.504.4.1.2.
- F. Provide non-hardening resilient firestop material at penetrations, sleeves and passthroughs in acoustic construction assemblies.
1. Acceptable Products:
    - a. Specified Technologies, Inc.; Elastomeric Sealant ES100
    - b. Johns Manville; Firetemp CI Caulk.
    - c. 3M; Fire Barrier 2001 Silicone RTV Foam.
    - d. Hilti; Flexible Firestop Sealant CP 606.

## 2.3 **FILL MATERIALS**

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

- B. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable, heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Moisture-curing, 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 and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
- K. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional regulations as identified in CALgreen Section 5.504.4.
- L. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds shall comply with regulations as identified in CALgreen Section 5.504.4.1.2.
- M. Gypsum Products: The use of gypsum products for through-penetration firestopping is strictly prohibited.

## 2.4 MIXING

- A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:
  - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
  - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without damaging substrate or disturbing firestop system's seal with substrates.



### 3.3 INSTALLATION

- A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
  - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.4 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and installations comply with requirements.

### 3.5 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

**Gensler**  
005.2882.000

January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

**END OF SECTION**

## SECTION 07 84 43 - JOINT FIRESTOPPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section includes fire-resistive joint systems for the following:

1. Floor-to-floor joints.
2. Floor-to-wall joints.
3. Head-of-wall joints.
4. Bottom of wall joints.
5. Wall-to-wall joints.

#### 1.2 ACTION SUBMITTALS

A. **Product Data:** Submit product data for each type of product indicated.

B. **CALgreen Submittals:**

1. Product Data for Section 5.504.4.1: For sealants, adhesives and caulks, provide documentation including printed statement of VOC content showing compliance with SCAQMD Rule 1168 VOC limits and CCR (California Code of Regulations) Title 17 for aerosols.
2. Product Data for Section 5.504.4.1.2: Provide documentation for aerosol adhesives, and smaller unit sizes of adhesives, sealant, and caulking compounds (in units of product, less packaging, which do not weigh more than one (1) pound and do not consist of more than sixteen (16) fluid ounces) comply with statewide VOC standards and prohibitions on use of certain toxic compounds, of CCR Title 17, commencing with Section 94507.

C. **Fire-resistive Joint Systems Schedule:** Submit a Fire-resistive Joint Systems Schedule indicating the types of fire resistive joint system to be installed and the relationships to adjoining construction. Include fire-resistive joint system design designation of testing and inspecting agency acceptable to authorities having jurisdiction that demonstrates compliance with requirements for each condition indicated.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular fire-resistive joint system, submit illustration, with modifications marked, approved by the fire resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.
  - a. Engineering judgment shall include both project name and contractor's name who will install fire-resistive joint system as described in document.

### **1.3 INFORMATIONAL SUBMITTALS**

- A. Product Certificates: Signed by manufacturers of fire resistive joint system products certifying that products furnished comply with requirements.

### **1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: A firm or individual certified or licensed by the fire resistive joint system manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its fire resistive joint system materials to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.
  - 1. The installer must have no less than 3 years of experience with fire resistive joint system installation.
- B. Source Limitations: Obtain fire-resistive joint systems, for each kind of joint and construction condition indicated, through one source from a single manufacturer.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

### **1.6 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet.
- B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

### **1.7 COORDINATION**

- A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

- B. Coordinate sizing of joints to accommodate fire-resistive joint systems.
- C. Notify Owner's inspecting agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on days preceding each series of installations.
- D. Do not cover up fire-resistive joint 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 PERFORMANCE REQUIREMENTS**

- A. Fire-Test-Response Characteristics:
  - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
  - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
    - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
      - 1) UL in its "Fire Resistance Directory."
      - 2) Intertek Group in its "Directory of Listed Building Products."

### **2.2 JOINT FIRESTOPPING**

- A. General: Provide fire-resistive joint 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 fire-resistive joint systems are installed. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
  - 1. Gypsum Products: The use of gypsum products for joint firestopping is strictly prohibited.
- B. 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.
- C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide joint firestopping systems with rating determined per ASTM E 2307.

1. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
- D. Joints in Smoke Barriers: Provide joint firestopping systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg.
1. L-Rating: Not exceeding 5.0 cfm/ft. 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.
1. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional regulations as identified in CALgreen Section 5.504.4.
  2. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds shall comply with regulations as identified in CALgreen Section 5.504.4.1.2.

## 2.3 **FILL MATERIALS**

- A. Accessories: Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.
- B. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
- C. Silicone Sealants: Moisture-curing, 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 and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
- D. Accessories: Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of Work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
  1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
  2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
  3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates or damaging adjoining surfaces.

### 3.3 INSTALLATION

- A. General: Install joint firestopping systems to comply with Part 2 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. 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.
  1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for fire-resistive joint systems 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 FIELD QUALITY CONTROL**

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or joint firestopping system is damaged or removed because of testing, repair or replace joint firestopping system to comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and inspecting agency has approved installed fire-resistive joint systems.

### **3.5 CLEANING AND PROTECTING**

- A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

**END OF SECTION**



## SECTION 07 92 00 - JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes sealants for the following applications:
1. Exterior joints in the following vertical surfaces and nontraffic horizontal surfaces:
    - a. Control and expansion joints in cast-in-place concrete.
    - b. Control and expansion joints in unit masonry.
    - c. Joints in Portland cement plaster (stucco) systems.
    - d. Joints between metal panels.
    - e. Joints between glass for structural glazing.
    - f. Joints between different materials listed above.
    - g. Perimeter joints between materials listed above and frames of doors and windows and louvers.
    - h. Other joints as indicated.
  2. Exterior joints in the following horizontal traffic surfaces:
    - a. Control, expansion, and isolation joints in cast-in-place concrete slabs.
    - b. Tile control and expansion joints.
    - c. Joints between different materials listed above.
    - d. Other joints as indicated.
  3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Perimeter joints of exterior openings where indicated.
    - c. Tile control and expansion joints.
    - d. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
    - e. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - f. Joints between glass and glass to adjoining walls.
    - g. Other joints as indicated.
  4. Interior joints in the following horizontal traffic surfaces:
    - a. Control and expansion joints in cast-in-place concrete slabs.
    - b. Control and expansion joints in tile flooring.
    - c. Other joints as indicated.
- B. Single Subcontract Responsibilities: Refer to Section 08 41 13 "Aluminum-Framed Entrances and Storefronts," for requirements applicable to single subcontract responsibility.

## 1.2 QUALITY ASSURANCE

- A. Installer Qualifications: Exposed sealant work including, but not limited to, sealants used for air and weatherseals which are external to curtain wall systems at their perimeter, and metal panel to panel joints at their perimeter, shall be performed by one firm specializing in the installation of sealants who has successfully produced work comparable to this Project, in not less than three projects of similar scope to the satisfaction of the Architect, and whose work has resulted in construction with a record of successful in-service performance for a period of 10 years. Concealed sealant work (sealants which are internal to curtain wall systems, metal panels, and similar systems necessary for air and moisture penetration resistance under applied loads) shall be the responsibility of the subcontractor responsible for the final design, installation, and performance of the respective system.
- B. Source Limitations: Obtain each type of joint sealant, and each type of structural silicone adhesive, from a single manufacturer.
- C. Preconstruction Compatibility and Adhesion Testing (All Exterior Wall Sealants Only): Submit to joint sealant manufacturers, prior to full size building sample installation(s), samples of materials that will contact or affect, by direct or indirect chemical or mechanical means, exterior wall joint sealants for compatibility and adhesion testing below.
1. General: Test results confirming compatibility and adhesion are mandatory for all concealed and exposed sealant materials in contact with exterior glazing, unit masonry, other sealants, flashings, metal framing, and shims, prior to the construction of full sized sample installation(s).
    - a. Schedule sufficient time for testing and analysis of results to prevent delay in the progress of the work.
      - 1) It is anticipated that a minimum of 3 months will be required to complete preconstruction sealant compatibility and adhesion testing.
    - b. Investigate materials that fail compatibility and adhesion testing and obtain sealant manufacturer's written recommendations for corrective measures, which may include the use of primers, cleaners, cleaning measures, curing time, temperature limitations (surface and air), humidity conditions, moisture content of substrate, etc.
    - c. Definitions:
      - 1) Compatibility: The capability of the sealant materials and substrates to be placed in direct contact with each other and maintain their required physical, chemical and visual qualities with the absence of softening, staining, oil exudation, discoloration or other detrimental, deleterious or degradative effects caused by chemical interactions.
      - 2) Adhesion: The mechanical or chemical ability of the sealant materials and substrates to adhere or bond together at their interface.

- d. Specimen Sizes and Shapes: As required by the manufacturer's testing laboratory for the tests listed, unless otherwise specified.
2. Tests Required:
    - a. Adhesion in Peel Testing:
      - 1) Test Methods:
        - a) Comply with ASTM C 794 "Adhesion and Peel of Elastomeric Joint Sealants," modified to include Project specific substrates and to report cohesive or adhesive failure mode.
        - b) Comply with ASTM C 1135 "Determining Tensile Adhesion Properties of Structural Sealants," modified to include Project specific substrates and the following. Sealant manufacturer's modified interpretations of ASTM C 1135 will not be permitted. Samples of each exterior structural glazing and metal framing in contact with the structural sealant materials are required to be tested. In addition to the testing being performed under the standard environmental conditioning required of ASTM C 1135; the Contractor shall prepare, and test, additional specimens for each Project-specific environmental condition under which the sealant will be applied and cured.
      - 2) All specimens shall be tested for primed and unprimed performance.
      - 3) Report:
        - a) Date(s) of testing.
        - b) Project identification.
        - c) Test method (as identified herein).
        - d) Specimen substrate(s) tested.
        - e) Sealant(s) tested.
        - f) Substrate preparation (cleaning materials, methods and primers used).
        - g) Test results for each specimen tested (type of failure - adhesive or cohesive - force measured at failure in pounds per lineal inch).
        - h) Recommendations. Where testing shows equal or better performance without a primer, a primer will not be required.
        - i) Additional remarks, if any (i.e., color change of substrate or sealant, voids in the body of the sealant when examined in cross section, blistering, bubbling, sealant softening, or evidence of improperly mixed or cured sealant).
    - b. Compatibility Testing: This test method describes an accelerated laboratory procedure to determine if the proposed sealant materials and substrates are compatible.
      - 1) Test Methods:

- a) Comply with ASTM C 1248 "Staining of Porous Substances by Joint Sealants," modified to include Project specific substrates. Samples of each exterior face brick, and other sealants, in contact with the concealed and exposed sealant materials are required to be tested.
  - b) Comply with ASTM C 1087 "Determining Compatibility of Liquid Applied Sealants with Accessories Used in Structural Glazing Systems," modified to include Project specific substrates. Sealant manufacturer's modified interpretations of ASTM C 1087 will not be permitted. Samples of each exterior dry glazing gasket (if any), spacers, shims and setting blocks proposed for use in contact with the structural sealant materials are required to be tested.
- 2) All specimens for ASTM C 1248 testing shall be tested for primed and unprimed performance.
  - 3) Report:
    - a) Date(s) of testing.
    - b) Project identification.
    - c) Test method (as identified herein).
    - d) Substrate preparation (cleaning materials, methods and primers used).
    - e) Name of sealant, type of sealant, rated movement capability and identifying batch number.
    - f) Substrates used.
    - g) Testing Equipment: Manufacturer of apparatus, type of lamps.
    - h) Statement describing curing conditions if other than at standard conditions.
    - i) Description of, and reasons for, any variations from the test procedure.
    - j) Description of test effects observed, such as change in finished surface appearance, discoloration into the substrate, adhesion failure, or other characteristics; average measurement of stain width and depth.
    - k) Recommendations. Where testing shows equal or better performance without a primer, a primer will not be required.
    - l) Additional remarks, if any (i.e., color change of substrate or sealant, voids in the body of the sealant when examined in cross section, blistering, bubbling, sealant softening, or evidence of improperly mixed or cured sealant).
- c. Preconstruction Field-Adhesion Testing: Before installing exposed exterior elastomeric sealants, field test their adhesion to joint substrates as follows:
    - 1) Locate test joints where indicated or, if not indicated, as directed by Architect.
    - 2) Conduct field tests for each type of exposed exterior elastomeric sealant and joint substrate indicated.
    - 3) The Architect and manufacturer's technical representative shall be present when joints are tested.

- 4) Test Method: Test exterior elastomeric joint sealants by hand-pull method described below:
    - a) Install joint sealants in 60 inch long joints using same materials and methods for joint preparation and joint-sealant installation in accordance with manufacturer's final laboratory testing recommendations. Allow sealants to cure.
    - b) Make knife cuts from one side of joint to the other, followed by two cuts approximately 3 inch long at sides of joint and meeting cross cut at one end. Place a mark 1 inch from cross-cut end of 3 inch piece.
    - c) Use fingers to grasp 3 inch piece of sealant between cross-cut end and 1 inch mark; pull firmly down at a 90-degree angle to the joint and hold sealant in this position for ten seconds; following the ten second time duration pull sealant at a 180 degree angle parallel to the joint and hold the sealant in this position for ten seconds. Pull sealant away from joint to the distance recommended by sealant manufacturer for testing adhesion.
    - d) Repair joint as recommended by the sealant manufacturer.
  - 5) Sealants evidencing adhesive failure with one or both substrates during testing, and/or a level of elongation prior to failure that is not in compliance with the performance characteristics specified herein or otherwise published by the sealant manufacturer will be subject to rejection by the Architect. Discontinue use of joint sealants, cleaning agents, primers, and application methods associated with failures documented during testing and immediately notify manufacturer and Architect for further review.
3. Report: Provide written summary of each compatibility and adhesion test.
- D. Mockups and Sample Installations:** Provide mockups and sample installations of sealants at locations indicated or required by the Architect. Mockups and sample installations shall represent the primary types of materials, substrate surfaces, joint size, exposure, and other conditions to be encountered in the work. Preparation, priming, application, and curing, shall comply with manufacturer's recommendations and actual proposed methods. Schedule the applications, with allowance for sufficient curing time, so that samples may be examined and necessary adjustments made at least one week prior to date scheduled for commencing installation of the work.
1. The mockups and sample installations shall be visually examined for staining, dirt pickup, shrinkage, color, general workmanship and appearance. Cut and pull the sealant from each sample joint to examine for internal bubbles or voids, adhesion, and general compatibility with substrate.
  2. Mockups and sample installations are required in conjunction with the following:
    - a. Section 08 41 13 "Aluminum-Framed Entrances and Storefront."
    - b. Section 08 44 13 "Glazed Aluminum Curtain Walls."

- E. Preinstallation Conference: As soon as possible after award of exterior joint sealant work, but no later than two weeks before the installation of the joint sealants, meet with Installer, Owner, Architect, installers of the substrate construction, and other work adjoining joint sealants and representatives of any other entities directly concerned with joint sealant performance. Conduct conference at Project site to comply with the following:
1. Review foreseeable methods and procedures related to sealing substrates, including but not limited to, the following:
    - a. Discuss substrates to be sealed, discuss as fabricated and installed condition of substrate, sealant application, flashing details, and other preparatory work.
    - b. Review joint sealant requirements: drawings, specifications, and other contract documents.
    - c. Review required submittals, both complete and incomplete.
    - d. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions.
    - e. Review schedule and intended sequence of work.
    - f. Review changes arising from the pre-construction mockup and performance testing program, if any.
    - g. Review the purpose and method of integration of field quality assurance programs developed by Contractor and suppliers/subcontractors responsible for the Work.
    - h. Review purpose and method of integration of field quality assurance program administered by the Owner's Exterior Wall Testing and Inspection Agency with similarly aligned programs developed by the Contractor and suppliers/subcontractors responsible for the Work.
  2. Record discussion and furnish copy of recorded discussions to each attendee.

### **1.3** **WARRANTY**

- A. Special Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealant work which has failed to provide a weathertight system within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranties: Written warranties (weatherseal and stain resistance), signed by elastomeric sealant manufacturer agreeing to furnish elastomeric joint sealants to repair or replace those that fail to provide airtight and watertight joints, or fail in adhesion, cohesion, abrasion-resistance, stain-resistance, weather resistance, or general durability or appear to deteriorate in any other manner not clearly specified in the manufacturer's data as an inherent quality of the material within specified warranty period.
1. Warranty Period:
    - a. For Polyurethane Sealants: 5 years from date of Substantial Completion.
    - b. For Silicone Sealants: 20 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS, GENERAL**

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as stated by sealant manufacturer's published data, and as substantiated by the manufacturer for each application through testing.
- B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
  - 1. Architectural Sealants: Not more than 250 g/L.
  - 2. Sealant Primers for Nonporous Substrates: Not more than 250 g/L.
  - 3. Sealant Primers for Porous Substrates: Not more than 775 g/L.
- C. Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system 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. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional regulations as shown in Section 01 81 23 "CALgreen Requirements."
- E. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds shall comply with regulations as shown in Section 01 81 23 "CALgreen Requirements."
- F. Colors: For fully concealed joints, provide manufacturer's standard color of sealant which has the best overall performance characteristics for the application shown. For exposed joints provide custom colors to match Architect's samples of the following:
  - 1. Exterior window and curtain wall framing, each color.
  - 2. Metal panels, each color.
  - 3. Walks and pavings, each color.
  - 4. Exterior field applied paints and coatings, each color.
  - 5. Other exterior and interior materials, each color as indicated.
- G. Manufacturer's Representative: Do not use elastomeric sealant produced by a manufacturer who will not agree to send a qualified technical representative to the Project site when requested, for the purpose of rendering advice concerning the proper installation of manufacturer's materials.

## 2.2 ELASTOMERIC JOINT SEALANTS

### A. Silicone Sealants for Vertical Applications (Non-Sag):

1. Typical Interior Glass Wall Butt Joints: Comply with ASTM C 1184 and ASTM C 920, Type S, Grade NS, Class 50; use NT, G, and A, black color unless otherwise indicated.
  - a. Products and Manufacturers: One of the following:
    - 1) Spectrem 2; Tremco, an RPM Co.
    - 2) Silpruf SCS 2000; Momentive.
    - 3) Sika, Sikasil WS 295.
  2. Typical Exterior Wall Joints:
    - a. Properties:
      - 1) Standards: Comply with ASTM C 920, Type M or S, Grade NS, Class 25 or 50; use NT, M, A and O.
      - 2) Performance: Non-stain, non-bleed, non-streaking to sealed and adjacent substrates. The minimum peel adhesion value after 7 day immersion shall not be less than 13 pli when tested in strict accordance with ASTM C 794 Adhesion in Peel.
      - 3) Cure System and Oil Content: Neutral-cure, low or medium modulus system specifically manufactured with controlled oil content to eliminate oil migration into sealed substrates and residue rundown over and onto adjacent substrates.
    - b. Products and Manufacturers: One of the following:
      - 1) DOWSIL 756 SMS; Dow Chemical Company.
      - 2) Spectrem 3 or Spectrem 4-TS (Use Spectrem 1 for metal to metal joints); Tremco, an RPM Co.
      - 3) Silpruf NB SCS 9000 (use Silpruf SCS 2000 for metal to metal joints); Momentive.
  3. Structural Glazing at Exterior Curtain Walls:
    - a. Structural and Weatherseal Beads for 2-side Field Glazed Structural Curtainwall Joints:
      - 1) Properties:
        - a) Standards: Comply with ASTM C 1184 and ASTM C 920, Type S, Grade NS, Class 25 or 50; use NT, G, and A.



- b) Performance: The minimum tensile adhesion strength shall be 120 psi with the sealant design tensile and shear stress calculated at 20 psi resulting in a minimum 6 to 1 safety factor. Provide laboratory testing and calculations indicating product working stress and safety factors, in addition provide insulating glass manufacturer's written concurrence, based on testing to actual job production run samples of glass and framing materials, the product is proper for the uses shown and specified.
  - c) Cure System: Shelf storage stable, neutral-cure, high modulus, system which is compatible and adherent to the two part insulating glass edge seals, glazing accessories and metal window frame materials being provided for the Project.
  - d) Color: Black.
- 2) Products and Manufacturers:
- a) DOWSIL 995 Silicone Structural Adhesive; Dow Chemical Company.
  - b) Proglaze SSG; Tremco, and RPM Co.
  - c) UltraGlaze SSG 4000; Momenitive.
- B. Two-Part Polyurethane Sealant for Paving Applications:
- 1. For Paving Applications with Slopes not Exceeding 5% (Self Leveling): ASTM C 920, Type M, Grade P, Class 25; use T (except with a Shore A hardness of 35 or greater) and I (Class 1 or 2) for water immersion; and abrasion resistant,; one of the following:
    - a. Pecora Corporation; Urexpam NR-200.
    - b. Tremco, an RPM Co.; Vulkem, 445SSL.
    - c. Sika; Sikaflex 1c SL.
  - 2. For Paving Applications with Slopes Exceeding 5%: ASTM C 920, Type M, Grade P "Slope Grade," Class 25; uses T (except with a Shore A hardness of 35 or greater) and I (Class 1 or 2) for water immersion; and abrasion resistant; one of the following:
    - a. Pecora Corporation; Dynatred.
    - b. Tremco, an RPM Co.; Vulkem, 445SSL.
- C. Sealants for Contact with Food: Comply with 21 CFR 177.2600, NSF Standard 51, and ASTM C 920 for Type S, Grade NS, Class 25, Use NT.
- 1. Dow Chemical Company; 786 Silicone Sealant.
- D. Mildew-Resistant Silicone Sealant (use for joints at toilet fixtures, toilet room countertops and vanities, and at janitor closet mop receptor to wall transition): Complying with ASTM C 920, Type S (single component), Grade NS (non-sag), class 25, Use NT (non-traffic), Substrate uses G, A, and O; and containing a fungicide for mildew resistance; white color.
- 1. Products: Provide one of the following:

- a. Dow Chemical Company; 786 Silicone Sealant.
- b. Momentive; Sanitary SCS 1700.
- c. Pecora Corporation; 898 Silicone Sanitary Sealant.
- d. Tremco, an RPM Co.; Tremsil 200 Sanitary.

### 2.3 LATEX JOINT SEALANTS

- A. Latex Sealant: Non-elastomeric, one part, non-sag, paintable latex sealant that is recommended for exposed applications on the interior. Complying with ASTM C 834, Type OP (opaque sealants):
  1. Products: Provide one of the following:
    - a. Pecora Corporation; AC-20 + Silicone.
    - b. DAP Products Inc.; Alex Plus Acrylic Latex Caulk Plus Silicone.
    - c. BASF; MasterSeal NP 520.
    - d. Tremco, an RPM Co.; Tremflex 834.

### 2.4 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: One of the following preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding backings of flexible plastic foam complying with ASTM C 1330, and of type indicated below. Select shape and density of cylindrical sealant backings in consultation with the manufacturer for proper performance in specific condition of use in each case.
  1. Type C: Closed-cell polyethylene foam material with a surface skin, which is nonabsorbent to liquid water and gas, non-outgassing in unruptured state; one of the following:
    - a. HBR Closed Cell Backer Rod; Nomaco, Inc.
    - b. MasterSeal 920; BASF Master Builders.
    - c. Mile High Foam; Backer Rod Mfg., Inc.
  2. Type B: Bi-cellular reticulated, polymeric foam material with a surface skin, nonoutgassing, with a density of between 1.5-3.0 pcf per ASTM D 1622 and minimum tensile strength of greater than 29-38 psi per ASTM D 1623, and with water absorption less than 0.058 oz./cubic inch per ASTM C 1016; one of the following:
    - a. SofRod; Nomaco, Inc.
    - b. MasterSeal 921; BASF Master Builders.
    - c. Titan Foam; Backer Rod Mfg., Inc.

- C. Bond-Breaker Tape: Polyethylene, TFE fluorocarbon, 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.
- D. Weep and Vent Tubes: Clear plastic (PVC) tubing, minimum 1/4 inch inside diameter, and of length as required to extend between exterior face of sealant and open cavity behind.
  - 1. At window and curtain wall systems, where required by system designer, provide gutter termination of tube with preformed nipples suitable for sealing to gutter.

## 2.5 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended, as verified through compatibility and adhesion testing, by joint sealant manufacturer for the substrates indicated to be sealed.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and which will not stain nor mar the finish of surfaces adjacent to joints to which it is applied.

## PART 3 - EXECUTION

### 3.1 JOINT SEALANT SCHEDULE

- A. Exterior joints in the following vertical surfaces and nontraffic horizontal surfaces:
  - 1. Perimeter joints between storefronts, window wall, metal framing and adjacent materials: Silicone Sealants for Vertical Applications (Non-Sag), Typical Exterior Wall Joints.
  - 2. Control and expansion joints in cast-in-place concrete: Silicone Sealants for Vertical Applications (Non-Sag), Typical Exterior Wall Joints.
  - 3. Control and expansion joints in unit masonry: Silicone Sealants for Vertical Applications (Non-Sag), Typical Exterior Wall Joints.
  - 4. Joints in Portland cement plaster (stucco) systems: Silicone Sealants for Vertical Applications (Non-Sag), Typical Exterior Wall Joints.
  - 5. Joints between metal panels: Silicone Sealants for Vertical Applications (Non-Sag), Typical Exterior Wall Joints.
  - 6. Joints between glass for structural glazing: Structural Glazing at Exterior Curtain Walls.
  - 7. Joints between different materials listed above: Silicone Sealants for Vertical Applications (Non-Sag), Typical Exterior Wall Joints.

8. Perimeter joints between materials listed above and frames of doors and windows and louvers: Silicone Sealants for Vertical Applications (Non-Sag), Typical Exterior Wall Joints.
- B. Exterior joints in the following horizontal traffic surfaces:
1. Control, expansion, and isolation joints in cast-in-place concrete slabs: Two-Part Polyurethane Sealant for Paving Applications.
  2. Control and Expansion Joints in paving units, including steps and ramps: Two-Part Polyurethane Sealant for Paving Applications.
  3. Joints between different materials listed above: Two-Part Polyurethane Sealant for Paving Applications.
- C. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
1. Control and Expansion Joints on Exposed Interior Surfaces of Exterior Walls: Latex sealant.
  2. Perimeter Joints of Exterior Openings Where Indicated: Latex sealant.
  3. Vertical Control and Expansion Joints in Tile Surfaces: Latex sealant.
  4. Horizontal Control and Expansion Joints in Tile Flooring Surfaces: Two-Part Polyurethane Sealant for Paving Applications.
  5. Perimeter Joints between Interior Wall Surfaces and Frames of Interior Doors, Windows, and Elevator Entrances: Latex sealant.
  6. Perimeter Joints between Scalloped, Bent, or Warped Interior Wallboard Surfaces and Straight Trim: Latex Sealant.
  7. Joints between Plumbing Fixtures and Adjoining Walls, Floors, and Counters: Mildew resistant silicone sealant.
  8. Joints between Glass, and between Glass and Adjacent Substrates: Butt glazing sealant.

**END OF SECTION**

## SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section includes

1. Hollow metal doors and frames.
2. The integration of a security system into the hollow metal door and frame work is required. The Contractor shall be responsible for the total and complete coordination of the security system components into the Work.

#### 1.2 ACTION SUBMITTALS

A. **Product Data:** Submit product data for each product indicated. Include material descriptions, core descriptions, label compliance, sound and fire-resistance ratings, and finishes for each type of door and frame specified.

B. **CALgreen Submittals:**

1. Product Data for Section 5.504.4.3: For architectural paints and coatings, provide documentation including printed statement of VOC content showing compliance with Table 1 of the ARB, Architectural Coatings Suggested Control Measure, unless more stringent local limits apply.
2. Product Data for Section 5.504.4.3.1: Aerosol paints and coatings, provide documentation that products meet the PWMIR Limits for ROC in Section 94522 (a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Section 94522(c)(2 and (d)(2) of CCR Title 17.

C. **Shop Drawings:** Submit door and frame schedule using same reference designations indicated on Drawings. Include opening size(s), handing of doors, frame throat dimensions, details of each frame type, elevations of door design types, details of construction, location and installation requirements of door hardware and reinforcements, hardware group numbers, details of joints and connections, fire label requirements including fire rating time duration, maximum temperature rise requirements, and smoke label requirements.

1. Indicate routing of electrical conduit and dimensions and locations of cutouts in doors and frames to accept electric hardware devices.

### 1.3 QUALITY ASSURANCE

- A. Hollow Metal Door and Frame Standard: Comply with the applicable provisions and recommendations of the following publications by Hollow Metal Manufacturers Association (HMMA) Div. of National Association of Architectural Metal Manufacturers (NAAMM), unless more stringent requirements are indicated in the Contract Documents:
1. HMMA "Hollow Metal Manual."
  2. HMMA 861 "Guide Specifications for Commercial Hollow Metal Doors and Frames."
  3. HMMA 866 "Guide Specifications for Stainless Steel Hollow Metal Doors and Frames."
- B. Manufacturer Qualifications: A firm experienced in manufacturing hollow metal doors and frames similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames palleted, wrapped, or crated to provide protection during transit and Project site storage.
- B. Inspect doors and frames, on delivery, for damage. Tool marks, rust, blemishes, and other damage on exposed surfaces will not be acceptable. Remove and replace damaged items as directed by Architect. Store doors and frames at building site in a dry location, off the ground, and in such a manner as to prevent deterioration.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door 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 252 or UL 10C "Standard for Positive Pressure Fire Tests of Door Assemblies." Fire classification labels at all doors with fire ratings greater than 20 minutes shall indicate the temperature rise developed on the unexposed surface of the door after the first 30 minutes of fire exposure.
1. Provide metal labels permanently fastened on each door which is within the size limitations established by the labeling authority having jurisdiction.
  2. Positive Pressure Rated Door Assemblies: Where indicated provide positive pressure rated fire rated door assemblies. Sizes and configurations as shown on the Drawings. Installed door assemblies shall be in accordance with door manufacturer's certified assemblies.

- a. Test Pressure: Test according to NFPA 252 or UL 10C. After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches or less above the sill.
- B. Smoke-Control Door Assemblies: Provide assemblies with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- C. Thermally Rated Door Assemblies: Design, fabricate and install exterior door assemblies with the assembly U-factor maximum to comply with ASHRAE 90.1 and the IECC for the project specific geographic location of the building project when tested according to NFRC 100 (ASTM C 518).

## 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide doors and frames by one of the following:
  1. Hollow Metal Doors and Frames:
    - a. Ceco Door Products; an Assa Abloy Group Company.
    - b. Curries Company; an Assa Abloy Group Company.
    - c. Steelcraft; an Allegion PLC Company.

## 2.3 MATERIALS

- A. Hot-Rolled Steel Sheets: ASTM A 1011/A 1011M, CS (commercial steel), Type B, free of scale, pitting, or surface defects; pickled and oiled. Not less than 16 gauge, thick where frames are indicated to be built into exterior walls, hot dip galvanize after fabrication in compliance with ASTM A 153/A 153M, Class B.
- B. Cold-Rolled Steel Sheets: ASTM A 1008/A 1008M, CS (commercial steel), Type B; free from scale, pitting, coil breaks, surface blemishes, buckles, waves, or other defects, exposed (matte) dull finish, suitable for exposed applications.
- C. Metallic-Coated Steel Sheets: ASTM A 653/A 653M, CS (commercial steel), Type B; with G60 zinc (galvanized) or A60 zinc-iron-alloy (galvannealed) coating, mill phosphatized.
- D. Inserts, Bolts, and Fasteners: Galvanized or cadmium plated steel.
  1. Expansion Bolts and Shields: FS FF-S-325, Group III, Type 1 or 2.
  2. Machine Screws: FS FF-S-92, carbon steel, Type III cross recessed, design I or II recess, style 2C flat head.
- E. Filler: Sound deadening and heat retarding mineral fiber insulating material.

- F. Glass and Glazing: Refer to Section 08 80 00 "Glazing."
- G. Hardware: Refer to Section 08 71 00 "Door Hardware."
- H. Paints and coatings shall comply with VOC content as shown in CALgreen Section 5.504.4.3.

## 2.4 DOORS

- A. General: Provide flush-design doors, 1-3/4 inches thick, of seamless hollow construction, unless otherwise indicated. Construct doors with sheets joined at their vertical edges by continuous welding the full height of the door, or joined at vertical edges by 1 inch spot welds 6 inches on center, or intermittently welded seams. Voids between spot and intermediate welds shall be epoxy edge filled. Grind and finish all welds and edge fills flush to result in invisible seams on the door faces or vertical door edges.
  - 1. For single-acting swing doors, bevel both vertical edges 1/8 inch in 2 inches.
  - 2. For double-acting swing doors, round vertical edges with 2-1/8-inch radius.
- B. Interior Door Core Construction: Doors shall be stiffened by continuous vertically formed steel sections which, upon assembly, shall span the full thickness of the interior space between door faces. These stiffeners shall be 0.026-inch not more than 6 inches apart and spot welded to face sheets a maximum of 5 inches o.c. Place filler between stiffeners for full height of door.
- C. Exterior Door Core Construction: Subject to compliance with performance requirements, provide either polystyrene or polyurethane cores.
- D. Fire Door Cores: A continuous mineral fiberboard core permanently bonded to the inside face of the outer face sheet unless otherwise required to provide fire-protection and temperature-rise ratings indicated.
- E. Astragals: As required by NFPA 80 to provide fire ratings indicated.
- F. Top and Bottom Channels: Spot weld metal channel not less than thickness of face sheet to face sheets not more than 6 inches o.c.
  - 1. Reinforce tops and bottoms of doors with inverted horizontal channels of same material as face sheet so flanges of channels are even with bottom and top edges of face sheets.
  - 2. For exterior doors, close top edge with metallic-coated steel closing channel of same material, so webs of channels are flush with top door edges. Weld inverted steel channels to both face sheets or form integrally with edge construction of door.
- G. Hardware Reinforcement: Fabricate reinforcing from the same material as door to comply with the following. Offset reinforcement so that faces of mortised hardware items are flush with door surfaces.
  - 1. Hinges and Pivots: 7 gauge thick by 1-1/2 inches wide by 9 inches.



2. Lock Front, Strike, and Flushbolt Reinforcements: 12 gauge thick by size as required by hardware manufacturer.
  3. Lock Reinforcement Units: 14 gauge thick by size as required by hardware manufacturer.
  4. Closer Reinforcements: 12 gauge thick one-piece channel by size as required by hardware manufacturer.
  5. Other Hardware Reinforcements: As required for adequate strength and anchorage.
  6. In lieu of reinforcement specified, hardware manufacturer's recommended reinforcing units may be used.
  7. Exit Device Reinforcements: 0.250 inch thick by 10 inches high by 4 inches wide centered on exit device case body, unless otherwise recommended by exit device manufacturer.
- H. Electrical Requirements: Make provisions for installation of electrical items specified elsewhere; arrange so wiring can be readily removed and replaced.
1. Provide all cutouts and reinforcements required for hollow metal doors to accept security system components.
  2. Doors with Electric Hinges and Pivots: Provide with metal conduit or raceway to permit wiring from electric hinge or pivot to other electric door hardware.
    - a. Hinge Location: Center for doors less than 90 inches tall or second hinge from door bottom for doors greater than 90 inches; top or bottom electric hinge locations shall not be permitted.
- I. Interior Hollow Metal Doors:
1. Typical Interior Doors: Flush design with 18 gauge thick cold-rolled stretcher-leveled steel face sheets and other metal components from hot- or cold-rolled steel sheets.
- J. Exterior Hollow Metal Doors: Flush design with 16 gauge thick metallic-coated stretcher leveled steel face sheets, unless heavier gage is required to comply with the performance requirements, and other metal components from metallic coated steel sheets. Provide weep-hole openings in bottom of doors to permit entrapped moisture to escape.

## 2.5 WELDED FRAMES

- A. Fabricate hollow metal frames, formed to profiles indicated, with full 5/8 inch stops, and of the following minimum thicknesses.
1. For exterior use, form frames from 14 gauge thick, metallic-coated steel sheets.
  2. For interior use, form frames from cold- rolled steel sheet of the following thicknesses:
    - a. Openings up to and Including 48 Inches Wide: 16 gauge.
    - b. Openings More Than 48 Inches Wide: 14 gauge.
  3. Frame heads at all masonry openings shall be formed to extend to the lowest CMU horizontal mortar joint.

- B. Provide frames either saw mitered and full (continuously) profile welded, or machine mitered and full profile welded, on back side at frame corners and stops with edges straight and true. Grind welds smooth and flush on exposed surfaces.
- C. Hardware Reinforcement: Fabricate reinforcements from same material as frame to comply with the following. Offset reinforcement so that faces of mortised hardware items are flush with surface of the frame.
1. Hinges and Pivots: 7 gauge thick by 1-1/4 inches wide by 10 inches.
  2. Strike, Surface Mounted Hold Open Arms, and Flushbolt Reinforcements: 12 gauge thick by size as required by hardware manufacturer.
  3. Closer Reinforcements: 12 gauge thick one piece channel by size as required by hardware manufacturer.
  4. Other Hardware Reinforcements: As required for adequate strength and anchorage.
- D. Electrical Requirements: Make provisions for installation of electrical items specified elsewhere; arrange so wiring can be readily removed and replaced.
1. Provide all cutouts and reinforcements required for steel frames to accept security system components.
  2. Frames with Electric Hinges and Pivots: Provide welded on UL listed back boxes with metal conduit or raceway to permit wiring from electric hinge or pivot to other electric door hardware.
    - a. Hinge Location: Center for doors less than 90 inches tall or second hinge from door bottom for doors greater than 90 inches; top or bottom electric hinge locations shall not be permitted.
- E. Jamb Anchors: Locate jamb anchors above hinges and directly opposite on strike jamb as required to secure frames to adjacent construction. At metal stud partitions locate the additional jamb anchor below the top hinge.
1. Metal-Stud Partitions: Metal channel stud zee anchor sized to match stud width, welded to back of frames, formed of same material and gauge thickness as frame. Unless closer spacing is required to meet the performance requirements provide at least the number of anchors for each jamb according to the following heights:
    - a. Three anchors per jamb up to 60 inches in height.
    - b. Four anchors per jamb from 60 to 90 inches in height.
    - c. Five anchors per jamb from 90 to 96 inches in height.
    - d. One additional anchor per jamb for each 24 inches or fraction thereof more than 96 inches in height.
- F. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, formed of same material as frame, 12 gauge thick, and punched with two holes to receive two 0.375 inch fasteners. Where floor fill or setting beds occur support frame by adjustable floor anchors bolted to the structural substrate. Terminate bottom of frames at finish floor surface. Weld floor anchors to frames with at least 4 spot welds per anchor.

- G. Head Strut Supports: Provide 3/8-by-2-inch vertical steel struts extending from top of frame at each jamb to supporting construction above. Bend top of struts to provide flush contact for securing to supporting construction above by bolting, welding, or other suitable anchorage. Provide adjustable wedged or bolted anchorage to frame jamb members to permit height adjustment during installation. Adapt jamb anchors at struts to permit adjustment.
- H. Head Reinforcement: For frames more than 48 inches wide in masonry wall openings, provide continuous steel channel or angle stiffener, 12 gauge thick for full width of opening, welded to back of frame at head. Head reinforcements shall not be used as a lintel or load-bearing member for masonry.
- I. Spreader Bars: Provide removable spreader bar across bottom of frames to serve as bracing during shipment and handling and to hold frames in proper position do not tack weld bars to frames.
- J. Door Silencer Holes: Drill strike jamb stop to receive three silencers on single door frames and for two silencers on double door frames. Insert plastic plugs in holes to keep holes clear during installation.

## 2.6 FABRICATION

- A. Fabricate doors and frames rigid, neat in appearance, and free of defects, warp, wave, and buckle. Accurately form metal to sizes and profiles indicated. Accurately machine, file, and fit exposed connections with hairline joints. Weld exposed joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
- B. Exposed Fasteners: Provide countersunk flat heads for exposed screws and bolts, unless otherwise indicated.
- C. Hardware Preparation: Prepare doors and frames to receive hardware, including cutouts, reinforcement, mortising, drilling, and tapping, according to final hardware schedule and templates provided by hardware supplier. Secure reinforcement by spot welding. Comply with applicable requirements of ANSI/BHMA A156.115 and A156.115W specifications for door and frame preparation for hardware. Factory-reinforce doors and frames to receive surface-applied hardware. Factory drill and tap for surface-applied hardware, except at pushplates and kickplates provide reinforcing only.
  - 1. Locate hardware as indicated on the Drawings or in Section 08 71 00 "Door Hardware" or, if not indicated, according to HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."

## 2.7 METALLIC-COATED STEEL FINISHES

- A. General: Clean, treat and prime surfaces of fabricated steel door and frame work, inside and out, whether exposed or concealed in the construction.

- B. 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 the organic coating 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.
- C. Factory Priming for Field-Painted Finish: Apply shop primer immediately after surface preparation and pretreatment. Apply a sufficient number of coats, baked on, to obtain uniformly smooth exposed surfaces. Touch up surfaces having runs, smears, or bare spots.
  - 1. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, lead- and chromate-free, primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for zinc-coated steel; compatible with substrate and field-applied finish paint system indicated.

## 2.8 STEEL SHEET FINISHES

- A. General: Clean, treat and prime surfaces of fabricated steel door and frame work, inside and out, whether exposed or concealed in the construction.
- B. 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, shavings, filings, and rust, if present, complying with SSPC-SP 3, "Power Tool Cleaning."
- C. Factory Priming for Field-Painted Finish: Apply shop primer immediately after surface preparation and pretreatment. Apply a sufficient number of coats, baked on, to obtain uniformly smooth exposed surfaces. Touch up surfaces having runs, smears, or bare spots.
  - 1. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, corrosion-inhibiting, lead- and chromate-free, universal primer complying with ANSI A250.10 acceptance criteria; compatible with substrate and field-applied finish paint system indicated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Install doors and frames according to the referenced standards, the Architect reviewed shop drawings, and manufacturer's written recommendations and installation instructions.
- B. Frames: Install frames where indicated. Extend frame anchorages below fills and finishes. Coordinate the installation of built-in anchors for wall and partition construction as required with other work.

1. Welded Frames:
    - a. Set masonry anchorage devices where required for securing frames to in-place concrete or masonry construction.
      - 1) Set anchorage devices opposite each anchor location as specified and anchorage device manufacturer's written instructions. Leave drilled holes rough, not reamed, and free of dust and debris.
    - b. Placing Frames: Remove temporary spreader bars prior to installation of the frames. Set frames accurately in position; plumb; align, and brace securely until permanent anchors are set.
      - 1) At concrete or masonry construction, set frames and secure in place with machine screws and masonry anchorage devices. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
      - 2) Anchor bottom of frames to floors through floor anchors with threaded fasteners.
      - 3) Field splice only at approved locations indicated on the shop drawings. Weld, grind, and finish as required to conceal evidence of splicing on exposed faces.
      - 4) Remove spreader bars only after frames are properly set and secured.
  2. At fire-rated openings, install frames according to NFPA 80.
- C. Doors:
1. Non-Fire Rated Doors: Fit non-fire-rated doors accurately in their respective frames, with the following clearances:
    - a. Jamb and Head: 3/32 inch.
    - b. Meeting Edges, Pairs of Doors: 1/8 inch.
    - c. Bottom: 3/8 inch, if no threshold or carpet.
    - d. Bottom: 1/8 inch, at threshold or carpet.
  2. Fire-Rated Doors: Install with clearances as specified in NFPA 80.
  3. Smoke Control Doors: Install according to NFPA 105.
- D. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow metal manufacturer's written instructions.
1. Secure stops with countersunk flat or oval head machine screws spaced uniformly not more than 9 inches
- E. Apply hardware in accordance with hardware manufacturer's instructions and Section 08 71 00 "Door Hardware." Drill and tap for machine screws as required. Do not use self tapping sheet metal screws. Adjust door installation to provide uniform clearance at head and jambs, and to contact stops uniformly. Adjust hardware items just prior to final inspection. Leave work in complete and proper operating condition.

### 3.2 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items just before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames that are 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 compatible air-drying primer.
  - 1. Finish Painting: Refer to Section 09 91 23 "Interior Painting" and Section 09 91 13 "Exterior Painting."
- C. Remove and replace defective work, including doors or frames that are warped, bowed, or otherwise defective.
- D. Institute protective measures required throughout the remainder of the construction period to ensure that the hollow metal doors and frames will be without damage or deterioration, at time of Substantial Completion.

**END OF SECTION**

## SECTION 08 33 23 - OVERHEAD COILING DOORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section includes the following types of overhead coiling doors:

1. **Fire-rated counter doors.**

#### 1.2 ACTION SUBMITTALS

- A. Product Data: Submit product data for each product indicated.
- B. Sustainable Design Submittals: Refer to Division 01 Section "Sustainable Design Requirements."
- C. Shop Drawings: Submit shop drawings including plans, elevations, sections, details of installation, wiring diagrams, and attachments to other Work.
1. Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.
- D. Samples: Submit samples for each exposed finish.

#### 1.3 QUALITY ASSURANCE

- A. **Fire-Rated Door Assemblies: Complying with NFPA 80, identical to assemblies tested per UL 10b, and labeled and listed for fire ratings indicated by UL, FM, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction.**
- B. **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.**

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Basis of Design: Subject to compliance with requirements, provide **Cornell ERC 11 Counter Door with AlarmGard**, or a comparable product by one of the following:
1. Alpine Overhead Doors, Inc.
  2. Cookson Company (The).

3. McKeon Rolling Steel Door Company, Inc.
4. Overhead Door Corporation.
5. Raynor Garage Doors.
6. Wayne-Dalton Corp.

## 2.2 PERFORMANCE REQUIREMENTS

- A. **Fire-Rated Door Assemblies: Complying with NFPA 80; listed and labeled by qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.**
- B. Operational Life: Design components to operate for not less than 20,000 cycles.
  1. Operation Cycle: One complete cycle begins with door in closed position. Door is then moved to open position and back to closed position.
  2. Include tamperproof cycle counter.

## 2.3 DOOR CURTAIN AND CONSTRUCTION

- A. Door Curtain: Interlocking slats in continuous length for width of door. Unless otherwise indicated, slats of material thickness recommended by door manufacturer for performance, size, and type of door indicated.
  1. Steel Door Curtain Slats: Structural-quality, cold-rolled galvanized steel sheets, ASTM A 653/A 653M, with G90 zinc coating.
  2. Slat Type: Flat profile.
    - a. Inside Curtain Slat Face: Match material of outside metal curtain slat.
- B. Endlocks, General: Locate locks on every other curtain slat for curtain alignment and resistance against lateral movement.
- C. Bottom Bar: Continuous channel or tubular shape, in material matching curtain slats.
  1. Astragal: Replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene that is cushion bumper for interior door.
  2. Motor-Operated Doors: With combination bottom astragal and sensor edge.
- D. Curtain Jamb Guides: Steel angles, or channels and angles, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading.
  1. Counter Doors: Prevent metal-to-metal contact and minimize noise of travel with continuous integral wear strips and prevent overtravel of curtain with removable stops on guides.



## 2.4 HOODS AND ACCESSORIES

- A. Hood: Form to enclose coiled curtain and operating mechanism at opening head and act as weatherseal. Contour to suit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sag.
1. Steel-Door Hoods: Fabricate from not less than 0.028 inch thick, hot-dip galvanized steel sheet that matches slat material.
  2. **Fire-Rated Assemblies: Include automatic drop baffle to guard against passage of smoke or flame.**
  3. Shape: Round.
- B. Smoke Seals: UL-listed and -tested, smoke-seal perimeter gaskets.
- C. Push/Pull Handles: For push-up-operated or emergency-operated doors, provide galvanized steel lifting handles on each side of door.
1. Provide pull-down straps or pole hooks for doors more than 84 inches high.
- D. Fabricate locking device assembly with lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bar to engage through slots in tracks.
1. Lock Cylinder: As specified in Section 08 71 00 "Door Hardware."
- E. Power-Operated Doors: With safety interlock switch to disengage power supply when door is locked.
- F. **Fire-Rated Assemblies: With automatic-closing device inoperative during normal door operations, with governor unit complying with requirements in NFPA 80, with easily tested and reset release mechanism, and designed to be activated by the following:**
1. **Building fire alarm and detection system and door-holder-release devices.**
- G. Counterbalancing Mechanism: Adjustable, oil-tempered, heat-treated steel helical torsion springs mounted around structural carbon-steel pipe, and contained in barrel of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load; with grease-sealed bearings or self-lubricating graphite bearings.
1. Mounting Brackets: Cast-iron or cold-rolled steel plate with bell-mouth guide groove for curtain.

- H. Electric Door Operator: Type, size, and capacity recommended and provided by door manufacturer for door and operational life 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, disconnect device, emergency auxiliary operator, and accessories required for proper operation.**
- 1. Comply with NFPA 70. Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.**
  - 2. Electric Motors: Polyphase, medium-induction type with 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 2/3 fps or more than 1 fps, without exceeding nameplate ratings or considering service factor. Coordinate wiring requirements and electric characteristics of motors with building electrical system.**
    - a. Provide open dripproof-type motor, and controller with NEMA ICS 6, Type 1 enclosure.**
  - 3. Control Equipment: NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc. Provide momentary-contact, three-button control station.**
    - a. Interior Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.**

## **2.5 FINISHES**

- A. Steel Finish:** Manufacturer's standard factory-applied primer, compatible with field-applied finish.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General:** Install door and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports.
- 1. Fire-Rated Doors: Install to comply with NFPA 80.**
- B. Lubricate bearings and sliding parts; adjust doors to operate easily, free from warp, twist, or distortion for entire perimeter.**

**3.2 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain doors. Refer to Section 01 79 00 "Demonstration and Training."

**END OF SECTION**

## **SECTION 08 34 73 – SOUND CONTROL DOORS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes all labor, material, accessories and equipment necessary to provide sound control doors (including door, gaskets, hardware and door frame) where shown on the drawings and as specified below. Furnish and install acoustical door gaskets on building standard doors.

#### **1.3 RELATED WORK SPECIFIED ELSEWHERE**

- A. Division 0, Conditions of the Contract, and Division 1, General Requirements, apply to the Work of this Section.
- B. Section 03 60 00 – Grouting.
- C. Section 08 10 00 – Metal Doors and Frames.
- D. Section 08 71 00 – Door Hardware.
- E. Section 09 91 00 – Painting.

#### **1.4 REFERENCES**

- A. ASTM E90 – Standard Test Method for laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- B. ASTM E336 – Standard Test Method for Measurement of Airborne Sound Insulation in Buildings.
- C. ASTM E413 – Classification for Rating Sound Insulation.

#### **1.5 SUBMITTALS**

- A. Compliance: Comply with pertinent provisions of Division 1 – General Requirements.
- B. Specifications: Submit Manufacturer’s specifications and other data needed to prove compliance with all specified requirements.

- C. Installation Instructions: Submit Manufacturer's recommended installation instructions and procedures.
- D. Shop Drawings: Submit large scale shop drawings showing elevation of all sound control doors and frames, jamb and head details, hardware reinforcing details of doors and frames, door and frame location schedule, complete door and frame descriptive nomenclature, material description and gauges, astragal and meeting stile details, methods of anchorage, hardware preparation locations and gaskets, cam lift hinges and door manufacturer's other proprietary hardware.
- E. Acoustical Laboratory Test Reports: Submit Manufacturer's STC values for each of the specified doors. Sound transmission loss and STC values shall be based on measurements conducted by a laboratory accredited for specific acoustical testing under the National Voluntary Laboratory Accreditation Program (NVLAP) and in accordance with ASTM E 90.
- F. Certification: Manufacturer shall certify that the sound control doors (including doors, door frames, hardware and all head, jamb, astragal gaskets, etc) meet or exceed the specified laboratory STC values listed below when tested in accordance with ASTM E90.

## **1.6 ACOUSTICAL PERFORMANCE REQUIREMENTS**

- A. Provide sound control door assemblies (door leaf, frames, vision lites, acoustical gaskets, etc) that comply with the minimum Sound Transmission Class (STC) and Noise Isolation Class (NIC) values specified below for doors scheduled on the drawings. STC values shall be based on laboratory acoustical testing, which is performed by a National Voluntary Laboratory Accreditation Program (NVLAP) approved testing laboratory. Testing shall be performed in accordance with ATSM E90. NIC values shall be based on field acoustical testing performed by a qualified acoustical consultant who has a minimum of 5-years' experience in sound isolation measurements. Field testing shall be performed in accordance with ASTM E336 and ASTM E413.

## **1.7 QUALITY ASSURANCE**

- A. Manufacturer's Qualifications: The Manufacturer shall have successful experience in the fabrication and installation of sound control doors, including no less than 5 years experience in the fabrication and installation of doors equal to the size and complexity of this work. Upon request, the manufacturer shall provide references and acoustical test reports for three similar recently completed projects.
- B. Installer qualifications: Sound control door and frame assemblies must be installed by manufacturer, manufacturer's authorized distributor or an installer qualified in the installation and maintenance of specified equipment as approved by manufacturer.
- C. Single Source Responsibility: A single firm shall be responsible for the design, and fabrication of the sound control doors (including all accessories and hardware).

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

- A. Comply with pertinent provisions of Division 1 – General Requirements.
- B. Protect products during transit, storage and handling to prevent damage, soiling and deterioration. Comply with the requirements of the manufacturer’s instructions for storage and handling.
- C. Store doors upright, in a protected dry area, at least 1-inch or more off of the ground or floor and provide at least 1/4-inch space between individual doors.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Noise Barriers, Lake Forest, IL 847-843-0500
- B. IAC Acoustics, Naperville, IL 630-270-1790
- C. Ceco Doors, Milan, TN (888) 264-7474.
- D. VT Industries, Holstein, IA (800) 827-1615.
- E. Or equal.

### **2.2 MATERIALS**

- A. Type SCD-1: STC 50 Acoustical Door
  - 1. Operation: Manual.
  - 2. Opening Sizes: As scheduled on drawings.
  - 3. Door bottom gaskets: Acoustical gaskets to achieve STC rating.
  - 4. Jamb and head gaskets: Acoustical gaskets to achieve STC rating.
  - 5. Meeting stile gaskets: Acoustical gaskets to achieve STC rating.
  - 6. Hinges: Hinges to achieve STC rating
  - 7. Threshold: Acoustical gasketed threshold or hard, solid flat surface, such as concrete or a flat steel plate caulked and fastened to floor as needed to achieve STC rating. Grout raised thresholds to the floor.
  - 8. Door frames: Heavy gauge steel frames sealed to adjacent walls. Hollow cavities of frames (head and jamb) shall be filled as per acoustical test report to achieve STC rating. Edges of frames shall be caulked or grouted to walls.
  - 9. Vision lite: Size and composition of vision lite shall be as needed to achieve the door assembly STC rating. U.L. approved, finished flush with door face, with no visible fasteners on either door face.
  - 10. Laboratory Acoustical Performance: STC-50 Min.
  - 11. Field Acoustical Performance: NIC 47 Min.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General: Install sound control doors in accordance with manufacturer's recommendations, instructions and under manufacturer's supervision. The door Manufacturer shall work closely with the Contractor and shall have ultimate responsibility for the installations. Manufacturer shall coordinate field installations by providing detailed advice and field supervision.
- B. Installer shall examine door openings to verify that openings comply with the indicated requirements for type, size, location and acoustic characteristics. Installer shall also verify that openings are free of defects that could cause the doors to fail the sound isolation performance requirements. Installer shall not proceed with installation until all unsatisfactory conditions have been corrected.
- C. Do not install doors or frames that are observed to be warped, bowed, deformed or otherwise damaged or defaced to such an extent as to impair strength, appearance and sound isolation properties. Remove and replace components that have been damaged in the process of installation.
- D. Door Frames:
  - 1. Set frames accurately in location, in perfect alignment, plumb, straight and true. Brace frames to prevent displacement. Coordinate installation of built-in anchors for wall and partition construction as required with other work.
  - 2. During installation, fill door frames solid with poured grout in masonry or concrete walls or tightly packed with fiberglass or mineral wool insulation in metal stud walls.
- E. Doors:
  - 1. Apply hardware in accordance with hardware manufacturer's templates and instructions.
  - 2. Align and adjust all door components (door frames, panels, gaskets, hardware, etc.) in accordance with Manufacturer's instructions

### **3.2 ADJUSTING**

- A. Upon completion of work and before final inspection, adjust all gaskets to provide airtight seals with no visible gaps or spaces around all sound control doors. No light leaks shall be visible at the gasket seals. Once properly adjusted, the door gaskets shall provide a firm uniform compression seal around the perimeters of the doors.
- B. Once fully adjusted all sound control doors and associated hardware shall operate smoothly and properly. Adjust or replace doors that do not operate freely or are damaged.

### **3.3 CLEANING**

- A. A.Clean all door surfaces, seals, jambs and thresholds after installation. Exercise care to avoid damage to protective coatings and finishes. Remove excess sealant, grout, dirt and other substances. Lubricate hardware and other moving parts.

### **3.4 PROTECTION**

- A. Protection of sound control doors from damage shall be provided in accordance with manufacturer's recommendations such that doors will be undamaged at project completion. Protection from damage by other trades after installation of doors shall be provided by the General Contractor. Gaskets deformed as a result of door shoes or other devices used to hold the sound control doors open shall be replaced at no cost to the owner.

**END OF SECTION 08 34 73**



**Waveguide LLC**  
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January 10, 2022  
DSA Back Check

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

## **SECTION 08 36 13 - SECTIONAL DOORS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes electrically operated sectional doors.
- B. Related Requirements:
  - 1. Section 05 50 00 "Metal Fabrications" for miscellaneous steel supports.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type and size of sectional door and accessory.
  - 1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
  - 4. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied finishes.
  - 1. Include Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:
  - 1. Frame for paneled door sections; of each width of stile and rail required.

#### **1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For sectional doors to include in maintenance manuals.

#### **1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
- B. Regulatory Requirements: Comply with applicable provisions in the US Department Of Justice's "2010 ADA Standards for Accessible Design" and 2019 California Building Code.

#### **1.6 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including, but not limited to, excessive deflection.
    - b. Failure of components or operators before reaching required number of operation cycles.
    - c. Faulty operation of hardware.
    - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
    - e. Delamination of exterior or interior facing materials.
  - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS, GENERAL**

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

## 2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Sectional doors shall comply with performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
- B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
  - 1. Design Wind Load: As indicated on Drawings.
  - 2. Testing: According to ASTM E 330.
  - 3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.
    - a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of the door width.
    - b. Deflection of horizontal track assembly shall not exceed 1/240 of the door height.
  - 4. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.
- C. Seismic Performance: Sectional doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. Component Importance Factor: 1.0.

## 2.3 DOOR ASSEMBLIES

- A. Full-Vision Aluminum Sectional Door: Sectional door formed with hinged sections and fabricated according to DASMA 102 unless otherwise indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Amarr Garage Doors.
    - b. C.H.I. Overhead Doors, Inc.
    - c. Clopay Building Products.
    - d. Fimbel Architectural Door Specialties.
    - e. Overhead Door Corporation.
    - f. Raynor.
    - g. Wayne-Dalton Corp.
    - h. Windsor Door.
    - i. Or equal.
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

- C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E 283 or DASMA 105.
- D. Aluminum Sections: Full vision.
- E. Track Configuration: Vertical-lift track.
- F. Weatherseals: Fitted to bottom and top and around entire perimeter of door. Provide combination bottom weatherseal and sensor edge.
- G. Glazed Lights in Full Vision Doors: Configuration indicated on Drawings; installed with glazing of the following type:
  - 1. Insulating Glass: Manufacturer's standard 1/2 inch thick tempered glass insulating unit with low-E coating.
- H. Roller-Tire Material: Manufacturer's standard.
- I. Locking Devices: Equip door with locking device assembly and chain lock keeper.
  - 1. Locking Device Assembly: Cremona type, both jamb sides, locking bars, operable from inside and outside, with cylinders.
- J. Counterbalance Type: Torsion spring or Weight counterbalance, as standard with manufacturer.
- K. Electric Door Operator:
  - 1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
  - 2. Operator Type: Manufacturer's standard for door requirements.
  - 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet or lower.
  - 4. Motor Exposure: Exterior, dusty, wet, or humid.
  - 5. Emergency Manual Operation: Chain type.
  - 6. Obstruction-Detection Device: Hard-wired, automatic pneumatic sensor edge on bottom section.
    - a. Sensor Edge Bulb Color: Black.
  - 7. Control Station: Where indicated on Drawings.
- L. Door Finish:
  - 1. Baked-Enamel or Powder-Coat Finish: Color and gloss matching Architect's sample.
  - 2. Finish of Interior Facing Material: Match finish of exterior section face.

## 2.4 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.5 ALUMINUM DOOR SECTIONS

- A. Sections: Extruded-aluminum stile and rail members with dimensions and profiles as indicated on Drawings; members joined by welding or with concealed, 1/4-inch- minimum diameter, aluminum or nonmagnetic stainless-steel through bolts, full height of door section; and with meeting rails shaped to provide a weather-resistant seal.
  - 1. Aluminum: ASTM B 221 extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; minimum thickness 0.065 inch for door section 1-3/4 inches deep, and as required to comply with requirements.
  - 2. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Ensure that reinforcement does not obstruct vision lites.
  - 3. Provide reinforcement for hardware attachment.
- B. Foamed-in-Place Thermal Insulation: Insulate interior of aluminum sections with door manufacturer's standard CFC-free polyurethane insulation, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load, and with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within aluminum sections and the interior facing material, with no exposed insulation.
- C. Full-Vision Sections: Manufacturer's standard, tubular, aluminum-framed section fully glazed with insulating glass units set in vinyl, rubber, or neoprene glazing channel and with removable extruded-vinyl or aluminum stops.

## 2.6 TRACKS, SUPPORTS, AND ACCESSORIES

- A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances indicated on Drawings, Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides for required door type, size, weight, and loading.
  - 1. Galvanized Steel: ASTM A 653/A 653M, minimum G60 zinc coating.
  - 2. Slope tracks at an angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.
  - 3. Track Reinforcement and Supports: Galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches apart for door-drop safety device.

- a. For Vertical Track: Continuous reinforcing angle attached to track and attached to wall with jamb brackets.
- B. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.

## 2.7 HARDWARE

- A. General: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.
- B. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch- nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible. Provide double-end hinges where required, for doors more than 16 feet wide unless otherwise recommended by door manufacturer.
- C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch- diameter roller tires for 3-inch- wide track and 2-inch- diameter roller tires for 2-inch- wide track.
- D. Push/Pull Handles: Equip each push-up operated or emergency-operated door with galvanized-steel lifting handles on each side of door, finished to match door.

## 2.8 LOCKING DEVICES

- A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded deadbolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
  - 1. Lock Cylinders: Cylinders specified in Section 08 71 00 "Door Hardware".
  - 2. Keys: Three for each cylinder.
- B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

## 2.9 COUNTERBALANCE MECHANISM

- A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A 229/A 229M, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.

- B. **Weight Counterbalance:** Counterbalance mechanism consisting of filled pipe weights that move vertically in a galvanized-steel weight pipe. Connect pipe weights with cable to weight-cable drums mounted on torsion shaft made of steel tube or solid steel.
- C. **Cable Drums and Shaft for Doors:** Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft. Provide one additional midpoint bracket for shafts up to 16 feetlong and two additional brackets at one-third points to support shafts more than 16 feet long unless closer spacing is recommended by door manufacturer.
- D. **Cables:** Galvanized-steel, multistrand, lifting cables with cable safety factor of at least 5 to 1.
- E. **Cable Safety Device:** Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.
- F. **Bracket:** Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
- G. **Bumper:** Provide spring bumper at each horizontal track to cushion door at end of opening operation.

## 2.10 ELECTRIC DOOR OPERATORS

- A. **General:** Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
  - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Chamberlain Group, Inc. (The).
    - b. Or equal.
  - 2. Comply with NFPA 70.
  - 3. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
- B. **Usage Classification:** Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. **Door-Operator Type:** Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.



- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.
  - 1. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
  - 2. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
  - 3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
  - 4. Use adjustable motor-mounting bases for belt-driven operators.
- E. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction Detection Device: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
  - 1. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device.
- G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure, push-button control labeled "Close."
- H. Emergency Manual Operation: Equip electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.
- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

## **2.11 GENERAL FINISH REQUIREMENTS**

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## **2.12 ALUMINUM FINISHES**

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

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

### **3.3 STARTUP SERVICES**

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

**3.4 ADJUSTING**

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.
- D. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780/A 780M.

**3.5 DEMONSTRATION**

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

**END OF SECTION**

## SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes interior aluminum-framed entrances and storefronts. The aluminum-framed entrance and storefront work includes the following:
1. Aluminum swing entrance doors and framing, including hardware, stripping and thresholds.
  2. Aluminum trim, and similar items.
  3. Painting and coating in conjunction with the above aluminum items.
  4. Internal steel and aluminum reinforcements.
  5. Internal and perimeter sealing, joint fillers, and gasketing systems.
  6. Anchors, shims, fasteners, inserts, expansion devices, accessories, support brackets and attachments.
  7. Glass and glazing.
  8. Security system components may be incorporated into the door and frame openings of all aluminum-framed entrance and storefront work at the Owner's option. Cooperate with the Owner's security system contractors if the Owner chooses to incorporate security system components during the course of the Work.
- B. Related Requirements:
1. Section 08 44 13.13 "Glazed Aluminum Window Walls" for exterior entrances.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's specifications and installation instructions for each aluminum-framed entrance and storefront product specified.
- B. CALgreen Submittals:
1. Product Data for Section 5.504.4.1.1: For sealants, adhesives and caulks, provide documentation including printed statement of VOC content showing compliance with SCAQMD Rule 1168 VOC limits and CCR (California Code of Regulations) Title 17 for aerosols.
  2. Product Data for Section 5.504.4.1.2: Provide documentation for aerosol adhesives, and smaller unit sizes of adhesives, sealant, and caulking compounds (in units of product, less packaging, which do not weigh more than one (1) pound and do not consist of more than sixteen (16) fluid ounces) comply with statewide VOC standards and prohibitions on use of certain toxic compounds, of CCR Title 17, commencing with Section 94507.

3. Product Data for Section 5.504.4.3: For architectural paints and coatings, provide documentation including printed statement of VOC content showing compliance with Table 1 of the ARB, Architectural Coatings Suggested Control Measure, unless more stringent local limits apply.
  4. Product Data for Section 5.504.4.3.1: Aerosol paints and coatings, provide documentation that products meet the PWMIR Limits for ROC in Section 94522 (a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Section 94522(c)(2 and (d)(2) of CCR Title 17.
- C. Shop Drawings: Shop Drawings for the Basis of Design system are bound into the Contract Documents. For manufacturers proposing alternate systems as substitutions, the following requirements apply:
1. Submit shop drawings showing scaled elevations, plans, and sections of the aluminum-framed entrance and storefront work. Full scale sections shall be prepared and submitted for details of the assemblies that cannot be shown in the elevations or sections. Include with shop drawings metal thickness of all metal components, glass thicknesses, metal finishes, location and installation requirements of door hardware and reinforcements, and all other pertinent information as necessary or requested by the Architect to indicate compliance with the Contract Documents. Details of field connections, anchorage, and their relationship to the work of others shall be clearly indicated for the coordination of the work by other building trades. Details of fastening and sealing methods and product joinery shall be shown to ensure proper performance of the field installation. No work shall be fabricated until shop drawings for that work have been approved by Architect for fabrication.
- D. Structural Calculations: For manufacturers proposing alternate systems as substitutions, the following requirements apply:
1. Submit copies of structural calculations indicating complete compliance with the specified performance requirements. Calculations shall be prepared, signed and sealed by a Professional Engineer registered in the state wherein the work is to be erected.
    - a. Review of structural calculations and Shop Drawings by the Project's Structural Engineer of Record (SEOR) is solely for the purpose of determining that the building structure is adequate to accommodate the loads and forces imposed upon it by the storefront system.
- E. Samples: Submit samples of the following before any work is fabricated:
1. Three paired sets of samples for each exposed metal finish required. Sample finishes shall be on the specified alloy, temper, and thickness of metal required for the work. Where finishes involve color and texture variations, include sample sets showing the full range of variations expected. Furnish samples in either 12 inch lengths of rails, or 12 inch squares of sheet.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Submit certified product test reports based on tests performed by an AAMA Accredited Laboratory clearly describing in written form, and in shop drawing form, compliance of each aluminum-framed entrance and storefront assembly with requirements indicated based on comprehensive testing.

### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Instructions: Submit copies of an assembled and bound maintenance manual, describing the devices and procedures to be followed in cleaning, adjusting, and maintaining the aluminum-framed entrance and storefront work. Include information for maintaining operable doors, operating hardware, and replacing weather stripping.

### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Subcontract the aluminum-framed entrance and storefront work to a firm which is specialized in the erection of entrances and storefronts and who has successfully installed work similar in design and extent to that required for the Project, in not less than three projects of similar scope to the satisfaction of the Architect, and whose work has resulted in construction with a record of successful in-service performance for a period of 10 years.
- B. Manufacturer Qualifications: The drawings and specifications are based on the system specified in Part 2 of this Section. For manufacturers proposing alternate systems as substitutions, the following requirements apply:
  - 1. Award the fabrication of aluminum framed entrances and storefront components to a single firm specializing in the fabrication of aluminum framed entrances and storefront components who has successfully produced work similar in design and extent to that required for the project, in not less than three projects of similar scope to the satisfaction of the Architect, and whose work has resulted in construction with a record of successful in-service performance for a period of 5 years. The fabricator shall have sufficient production capacity, have organized quality control and testing procedures, and published written and illustrated installation manuals, to produce and properly install the aluminum framed entrances and storefront assemblies required without causing delay in progress of the Work.
- C. Standards: Comply with the applicable provisions and recommendations of the following standards below, where standards conflict the more stringent shall apply:
  - 1. American Architectural Manufacturers Association (AAMA): "Aluminum Store Front and Entrance Design Guide Manual."
  - 2. American Institute of Steel Construction (AISC), "Steel Construction Manual," Current Edition.

3. ANSI Z97.1 and Federal Standard 16 CFR 1201, Consumer Product Safety Commission (CPSC): "Safety Standard for Architectural Glazing Materials," as published in the Code of Federal Regulations (CFR). Comply with the applicable requirements of the laws, codes, ordinances and regulations of Federal and Municipal authorities having jurisdiction, wherever requirements conflict the more stringent shall be required. Obtain approvals from all such authorities. As a minimum provide safety glazing complying with ANSI Z97.1 for Category A performance and 16 CFR Part 1201 for Category II performance.
  4. Welding Standards: Welding shall be performed by skilled and qualified mechanics. Welding shall be performed in accordance with the applicable provisions of AWS D1.1 "Structural Welding Code - Steel."
- D. Regulatory Requirements: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and 2019 California Building Code.

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

- A. Packaging of components shall be so selected to protect the components from damage during shipping and handling.
- B. Storage on Site: Store aluminum-framed entrance and storefront components in a location and in a manner to avoid damage to the components. Keep handling on site to a minimum. Exercise particular care to avoid damage to finishes of metals.

## **1.7 FIELD CONDITIONS**

- A. Field Measurements: Verify dimensions of supporting structure by field measurements before fabrication so that the entrance and storefront work will be accurately designed, fabricated and fitted to the structure. Indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work. Use Contractor's lines and benchmarks as a basis for measurements.
- B. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to, power supplies, fire alarm system and detection devices, access control system, security system, building control system.

## **1.8 WARRANTY**

- A. Special Warranty: Submit a 2 year written warranty, beginning from date of substantial completion, and executed by the Contractor, manufacturer and the aluminum-framed entrance and storefront installer agreeing to repair or replace components of entrance and storefront systems that develop defects in materials or workmanship within the specified warranty period. Defects include structural failures, sealant failures, deterioration of metals, metal finishes, failure of operating components to function properly, and any other evidence of failure or deterioration of the aluminum-framed entrance and storefront work to meet performance requirements.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Basis of Design and Permit Approval: The drawings and specifications are based on the following systems by Arcadia Manufacturing:
1. AF 450+ System (monolithic glass).
  2. T500-UA System (glazed to achieve STC 50 rating).
- B. Shop Drawings, prepared by engineers engaged by the Basis of Design manufacturer, are incorporated into the Contract Drawings. The intent of this process is that the Shop Drawings and calculations provided by the manufacturer are part of the documents approved by DSA for permitting and construction.
1. Substitutions: See Section 01 25 00-Substitution Procedures.
  2. Deferred Submittals: In addition to the requirements of Section 01 25 00, proposed substitutions to the Basis of Design system will require preparation of Deferred Submittal documentation, for review and approval by DSA. Contractor is required to allow sufficient time in the schedule for preparation of Deferred Submittal documentation, review by Architect and consultants, and DSA review, including corrections and back check.
    - a. Failure to do so will not justify delays or extensions of time.
    - b. Should acceptance of a substitution require significant revisions to the Contract Documents, Architect reserves the right to request Additional Services compensation for updating the Contract Documents.
- C. Source Limitations: Obtain aluminum framed entrances and storefronts from single source from single manufacturer.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. General: Provide aluminum-framed entrance and storefront systems meeting or exceeding the following performance requirements:
1. Structural Properties:
    - a. Lateral Loads: The aluminum-framed entrance and storefront work, including glass, shall be designed, fabricated and installed to withstand a maximum inward and outward lateral pressure of 5 lbf/sf for sidelights and 20 lbf/sq. ft. for the active door panels.
    - b. Seismic Loads: As indicated on Drawings.
    - c. Deflection Limitations:



- 1) Deflections: Base calculations for the following deflections upon the combination of maximum direct lateral pressures, building deflections, and erection tolerances.
    - a) The deflection of any framing member in a direction normal to the plane of the wall when subjected to the full lateral pressures specified above shall not exceed 1/175 of the glass edge length or 3/4 inch whichever is less, except limit deflection of glass to 1/2 inch.
    - b) Glass, sealants and interior finishes shall not be included to contribute to framing member strength, stiffness or lateral stability.
  - d. Dead Loads:
    - 1) Maximum full deadload deflections, parallel (in-plane) to wall plane, of framing members shall not reduce glass bite or glass coverage, to less than 75 percent of the design dimension, and shall not reduce edge clearance to less than 25 percent of design dimension or 1/8 inch whichever is greater.
    - 2) Limit deflections of metal members spanning door openings to 1/300. The clearance between the member and an operable door shall be no less than 1/16 inch.
    - 3) Twisting (rotation) of the horizontals due to the weight of the glass shall not exceed 1 degree, measured between ends and center of each span.
  - e. Operational (Traffic) Loads: Design and fabricate aluminum-framed entrances to withstand the operating loads which result from heavy traffic conditions using the specified hardware, without measurable permanent deflection. Limit elastic deflections so as to provide the normal degree of rigidity required to avoid glass breakage, air leaks and other objectionable results of excessive flexibility. Provide weatherstripping at stiles, sill and head rails of door leaves, to minimize sound leaks.
    - 1) Accommodate seismic movement as required by local code authorities to maintain exit doors in operable condition in case of seismic event.
- B. Building Frame Movement: Design, fabricate and install aluminum-framed entrances and storefronts to withstand building movements including loading deflections, shrinkage, creep and similar movements.
- C. Design Modifications:
1. Submit design modifications necessary to meet the performance requirements and field coordination.
  2. Variations in details or materials shall not adversely affect the appearance, durability or strength of components.
  3. Maintain the general design concept without altering size of members, profiles and alignment.

## 2.3 MATERIALS

- A. Aluminum: Conform to the requirements published in AA "Aluminum Standards and Data," referenced ASTM standards and the following. All aluminum extrusions shall be manufactured to dimensional tolerances so as to eliminate any edge projection or misalignment at joints. Unless otherwise specified, provide alloy and temper as required to suit performance requirements and finish(es) indicated. Provide concealed extruded bars, rods, shapes and tubes in alloys as recommended by the fabricator to join or reinforce assembly of exposed aluminum components.
1. Alloys:
    - a. Sheet and Plate: Alloy 5005 and ASTM B 209, "Anodizing Quality."
    - b. Extruded Bars, Rods, Shapes, and Tubes: Alloy 6063 and ASTM B 221, "Anodizing Quality."
    - c. Bars, Rods, and Wire: ASTM B 211.
  2. Welding Rods and Bare Electrodes: AWS A5.10.
- B. Carbon Steel: For carbon steel components required to join, reinforce or support the assembly of aluminum components provide carbon steel conforming to ASTM A 36/A 36M for structural shapes, plates, and bars; ASTM A 1008/A 1008M for cold-rolled sheet and strip; or ASTM A 1011/A 1011M for hot-rolled sheet and strip.
1. Refer to Section 05 50 00, Metal Fabrications, for carbon steel framing, embedments, anchors, and welding that is not primary building structure nor furnished by the entrance and storefront fabricator but is required to transmit live and deadloads from the entrance and storefront framing to the primary building structure.
- C. Glass and Glazing Materials: As specified in Section 08 80 00 "Glazing."
- D. Anchors and Fasteners:
1. Material: Carbon steel complying with either ASTM A325 or SAE Grade 5.
  2. Anchor and Fastener Metal Alloy Types, Designations and Standards: Alloys as selected by fabricator to prevent corrosion resistance with the components fastened. Do not use self-drilling, self-tapping type fasteners.
  3. Do not use exposed anchors and fasteners, except for hardware application. For hardware application, use countersunk Phillips flat-head machine screws finished to match framing members or hardware being fastened, unless otherwise indicated.
  4. Where fasteners are subject to loosening or turn out from thermal and structural movements, lateral loads, or vibration, use self-locking devices.
- E. Weather Stripping:

1. Compressible Weatherstripping: Compressible weatherstripping gaskets fabricated from extruded multi-fingered PVC, silicone or neoprene, replaceable, held in adjustable depth extruded metal strips to be mortised into edge of door panels for minimum exposure, metal finish to match finish of door.
2. Sliding Weather Stripping: Wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing complying with AAMA 701 requirements, replaceable, held in adjustable depth extruded metal strips to be mortised into edge of door panels for minimum exposure.

## 2.4 SEALING MATERIALS

- A. Concealed Sealing Materials: All sealing materials concealed within the entrances and storefronts shall be silicone, compatible with and adherent to each material it will be in contact with, as recommended by the manufacturer to fulfill performance requirements.
- B. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional regulations as shown in CALgreen Section 5.504.4.1.
- C. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds shall comply with regulations as shown in CALgreen Section 5.504.4.2.
- D. Exposed Sealing Materials: Sealants, exposed at entrance and storefront perimeter joints in contact with adjacent cladding materials are specified in Section 07 92 00 "Joint Sealants."

## 2.5 FABRICATION

- A. General: Fabricate the entrances and storefronts to the designs, shapes, and sizes shown using the materials specified and shown to produce assemblies which meet or exceed the performance requirements. To the greatest extent possible complete fabrication, assembly, finishing, hardware applications and other work before shipment to Project site.
  1. Metal Wall Thickness: Provide shapes as shown and as required to suit the performance requirements but with wall thickness of not less than 1/8 inch.
  2. Door Stile and Rail Dimensions:
    - a. Bottomrails: Provide minimum 10 inches high one piece bottomrail unless otherwise indicated on the Drawings.
    - b. Stiles and Top Rail Dimensions: As indicated on Drawings.
    - c. Door Thickness: 1-3/4 inches.
    - d. Preglaze door units to greatest extent possible, in coordination with installation and hardware requirements. Glazing, whether in factory or in field, shall be performed in accordance with Section 08 80 00 "Glazing."
    - e. Fabricate all doors and frames to accommodate the swing direction shown.
  3. Provide extruded aluminum entrance door inserts at door frames designed with bosses sized to receive selected door gasket.

- B. Glazing Stops and Gaskets: Provide continuous interior glazing stops with concealed fasteners for all doors and frames. Provide stops with hairline joints at corners. Provide stops with beveled, not square, shouldered profile unless otherwise shown.
- C. Glass Components: Provide holes and cutouts in glass to receive hardware and accessories before tempering glass. Drill, countersink, and chamfer holes using tooling, materials and methods which are selected and applied to prevent spalling of the cut glass surfaces at holes and cutouts. The internal surface of holes and cutouts shall be smooth with minimal roughness from drilling operations. Do not cut, drill, or make other alterations to glass after tempering.
  - 1. Fully temper glass using horizontal (roller-hearth) process and fabricate so, when installed, roll-wave distortion is parallel with bottom edge of door or lite.
  - 2. Heat Soaking: After tempering, expose 100% of all fabricated glass units to European Standard EN14179 heat soaking process to reduce the potential for inclusion related glass breakage.
  - 3. Factory assemble components and factory install hardware to greatest extent possible.
- D. Metal Components: Doors and frames shall be cut, reinforced, drilled and tapped in strict accordance with the printed door hardware manufacturer's templates and instructions. Provide solid steel hardware reinforcements, securely fastened to doors and frames where door hardware is to be attached.
  - 1. Security system components may be incorporated into the door and frame openings of all entrance doors and frames. Provide all cutouts required by the Owner's security system vendor and all prewiring for vendor provided security system devices. Wherever storefront and entrance framing components are to receive wiring, provide unobstructed clear paths free of burrs and sharp objects with pull strings to facilitate wiring.
- E. Joints in Metal Work: All exposed work shall be carefully fitted and matched to produce continuity of line and design, with all joints, being accurately fitted for hairline contact and rigidly secured. Where additional rigidity or strength is required to satisfy the performance requirements reinforce entrance components with aluminum or carbon steel shapes, bars, and plates.
- F. Shop Assembly: As far as practicable, all fitting and assembly work shall be done in a fabrication shop.
- G. Exposed Fasteners: Not permitted.

## 2.6 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
- B. Finish Application:
  - 1. Apply anodized coatings to all exposed surfaces of storefront and entrance components.

- C. Appearance of Finished Work: During production, maintain large size color range samples for use in comparing against production material. Variations in appearance of abutting or adjacent pieces are acceptable if they are within the range of approved samples. Noticeable variations in the same piece are not acceptable.
- D. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
- E. Class II, Color Anodic Finish: Complying with AA-M12C22A32/A34 for an Architectural Class II finish and the following:
  - 1. Metal Preparation and Pretreatment: Remove die markings prior to finishing operations. Perform this work in addition to the finish specified. Scratches, abrasions, dents and similar defects are unacceptable.
  - 2. Thickness: Minimum 0.4 mil, weighing not less than 15.5 mg per sq. in., minimum apparent density of 38 g per cubic in.
  - 3. Performance Criteria: Meets or exceeding AAMA 611.
  - 4. Color: Medium matte finished, integrally colored or electrolytically deposited color anodized matching Architect's sample.
  - 5. Post Anodizing Finish (Sealing): Anodized finishes shall be fully sealed by the manufacturer or processor according to procedures recommended by the licensor of the process. Maximum weight loss shall be 2.6 mg/ sq. in.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Coordinate entrance and storefront work with the work of other Sections and provide items to be placed during the installation of other work at the proper time to avoid delays in the work.
- B. Place such items, including concealed overhead framing, accurately in relation to the final location of entrance and storefront components.

#### **3.2 EXAMINATION**

- A. Examine the substrates, adjoining construction, and conditions under which the Work is to be installed. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Before beginning installation of the entrance and storefront work examine all parts of the existing building structural frame indicated to support the entrance and storefront work. Notify Contractor in writing, of any dimensions, or conditions, found which will prevent the proper execution of the entrance and storefront work, including specified tolerances. Use Contractor's offset lines and bench marks as basis of measurements.

### 3.3 INSTALLATION

- A. General: Comply with manufacturer's written instructions for protecting, handling, and installing entrance and storefront systems. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints.
1. Cut and trim component parts of the entrance and storefront work during erection only with the approval of the manufacturer or fabricator, and in accordance with his recommendations. Restore finish completely to protect material and remove all evidence of cutting and trimming. Remove and replace members where cutting and trimming has impaired strength or appearance, as directed by Architect.
  2. Set components within the erection tolerances with uniform joints. Place components on shims and fasten to supporting substrates using bolts and similar fasteners. Use stainless steel shims at structural connections only. U shaped shims at structural connections are not permitted. Use aluminum, stainless steel, or high impact polystyrene shims at other connections.
  3. Do not erect components which are warped, deformed, bowed, dented, defaced or otherwise damaged as to impair its strength or appearance. Remove and replace members damaged in the process of erection.
  4. No holes or slots shall be burned, cut into, or field drilled in building framing members without the written acceptance of the structural engineer.
- B. Entrance and Storefront Framing: Install framing components plumb and true in alignment with established lines and grades without warp or rack of framing members.
- C. Entrance Doors: Doors shall be securely anchored in place to a straight, plumb and level condition, without distortion. Adjust doors to operate smoothly, without binding, with hardware functioning properly. Weatherstripping contact, and hardware movement, shall be field tested and final adjustment, and lubrication, made for proper operation and performance of doors.
1. Door Hardware: Refer to Section 08 71 00 "Door Hardware."
- D. Install glazing to comply with requirements of Section 08 80 00 "Glazing," unless otherwise indicated.
- E. Install perimeter sealant to comply with requirements of Section 07 92 00 "Joint Sealants," unless otherwise indicated.
- F. Concealed Sealing Components: Apply sealant and gasket components which are integral to the entrance and storefront systems in strict accordance with the each component manufacturer's printed instructions. Before applying components remove all mortar, dust, dirt, moisture, and other foreign matter which will be deleterious to the intended performance of the component. Mask adjoining exposed surfaces to avoid spilling, dripping, dropping or other unintended contact of the sealing components onto adjacent exposed surfaces.

### **3.4 ERECTION TOLERANCES**

- A. The entrance and storefront systems shall be fabricated and erected to accommodate the dimensional tolerances of the structural frame while providing the following as installed tolerances.
1. Variation from theoretical calculated position as located in plan or elevation in relation to established floors lines, column lines and other fixed elements of the structure, including variations from plumb, level, straight and member size: +/- 1/4 inch max in any 20'-0" run, column-to-column bay, or floor-to-floor height.
  2. Alignment: Where surfaces abut in line, and meet at corners, limit offset from true alignment to 1/32 inch.
  3. Variation from angle, or plumb, shown: +/- 1/8 inch max in any 10'-0" run or story height, non-cumulative.
  4. Variation from slope, or level, shown: +/- 1/8 inch max in any 20'-0" run or column-to-column bay, non-cumulative.

### **3.5 ANCHORAGE**

- A. Anchorage of the entrance and storefront work to the structure shall be in accordance with the accepted shop drawings.

### **3.6 WELDING**

- A. Weld with electrodes and by methods recommended by manufacturer of material being welded, and in accordance with AWS D1.1 for concealed steel members.

### **3.7 REMOVAL OF DEBRIS**

- A. All debris caused by, or incidental to, the erection of the entrance and storefront work shall be removed from the site and disposed of legally.

### **3.8 CLEANING**

- A. Clean metal surfaces promptly after installation, exercising care to avoid damage to factory finished exposed surfaces.
- B. Wash glass on both faces not more than 4 days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer. Remove excess glazing and sealant compounds, dirt, and other substances.
- C. Immediately remove any deleterious material from surfaces of aluminum.

**3.9 PROTECTION**

- A. Institute protective measures required throughout the remainder of the construction period to ensure that entrance and storefront work will be without damage or deterioration, at time of acceptance.

**END OF SECTION**



## SECTION 08 44 13.13 - GLAZED ALUMINUM WINDOW WALLS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes glazed aluminum window wall assemblies for the entire project. The aluminum window wall assemblies work includes the following:
1. Aluminum window wall and storefront framing.
  2. Swinging entrance doors and framing, including hardware, stripping and thresholds.
  3. Aluminum shadow box metal back panels.
  4. Aluminum trim, snap in sealant stops, flashings, parapet copings, and similar items in conjunction with aluminum window wall assemblies.
  5. Painting and coating in conjunction with the above aluminum items.
  6. Internal steel and aluminum reinforcements.
  7. Internal and perimeter sealing, joint fillers, weeps, vents and gasketing systems.
  8. Anchors, embedments, shims, fasteners, inserts, expansion devices, accessories, support brackets, attachments, and grout.
  9. Exterior wall insulation.
  10. Glass and glazing for the windows, window walls, entrances and storefronts.
  11. Window, window wall, entrance and storefront sample installations.
  12. Window, and window wall laboratory mockup and testing, and field testing.
  13. Security system components may be incorporated into the door and frame openings of all entrance work at the Owner's option. Cooperate with the Owner's security system contractors if the Owner chooses to incorporate security system components during the course of the Work.
- B. The Owner will engage an independent testing and inspection agency to verify the adequacy of the Contractor's quality control; refer to Section 01 40 00 "Quality Requirements." Before concealing the window, and window wall work obtain the required inspections of same from a representative of the Owner's independent testing and inspection agency.
- C. Related Requirements:
1. Section 08 41 13 "Aluminum-Framed Entrances and Storefronts" for interior aluminum storefronts.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's specifications and installation instructions for each glazed aluminum window wall component specified.
- B. Shop Drawings: Shop Drawings for the Basis of Design system are bound into the Contract Documents. For manufacturers proposing alternate systems as substitutions, the following requirements apply:

1. Submit shop drawings showing scaled elevations, plans, and sections of the glazed aluminum window wall work. Full scale sections shall be prepared and submitted for details of the assemblies that cannot be shown in the elevations or sections. Include with shop drawings metal thickness of all metal components, glass thicknesses, metal finishes, location and installation requirements of door hardware and reinforcements, and all other pertinent information as necessary or requested by the Architect to indicate compliance with the Contract Documents. Details of field connections, anchorage, and their relationship to the work of others shall be clearly indicated for the coordination of the work by other building trades. Details of fastening and sealing methods and product joinery shall be shown to ensure proper performance of the field installation. No work shall be fabricated until shop drawings for that work have been approved by Architect for fabrication.
- C. Structural Calculations: For manufacturers proposing alternate systems as substitutions, the following requirements apply:
1. Copies of structural calculations for those elements of the exterior wall which are not represented by manufacturer test reports, indicating complete compliance with the specified performance requirements. Include calculations to show that maximum deflections do not exceed specified performance requirements under full design loading, calculations for frames, and glass manufacturer performed computer analyses showing that probability of breakage at the design wind pressure, and under the specified service temperature range, will not exceed the specified probability of breakage for each type, size, and thickness of glass that is not a part of the mockup testing program. Calculations shall be prepared, signed and sealed by a Professional Engineer registered in the state of California. The Engineer shall be experienced in providing engineering services on a minimum of 3 projects for the type of curtain wall work indicated. The engineer shall provide evidence of their design methodology, analysis, including all assumptions.
    - a. Review of structural calculations and Shop Drawings by the Project's Structural Engineer of Record (SEOR) is solely for the purpose of determining that the building structure is adequate to accommodate the loads and forces imposed upon it by the window wall system.
- D. Samples: Submit samples of the following before any work is fabricated:
1. Three paired sets of samples for each exposed metal finish required. Sample finishes shall be on the specified alloy, temper, and thickness of metal required for the work. Where finishes involve color and texture variations, include sample sets showing the full range of variations expected. Furnish samples in either 12 inch lengths of rails, or 12 inch squares of sheet.

### 1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: The drawings and specifications are based on the system specified in Part 2 of this Section. For manufacturers proposing alternate systems as substitutions, the following requirements apply:

1. Award the fabrication of glazed aluminum window wall components to a single firm specializing in the fabrication of glazed aluminum window wall components who has successfully produced work similar in design and extent to that required for the project, in not less than three projects of similar scope to the satisfaction of the Architect, and whose work has resulted in construction with a record of successful in-service performance for a period of 5 years. The fabricator shall have sufficient production capacity, have organized quality control and testing procedures, and published written and illustrated installation manuals, to produce and properly install the glazed aluminum window wall assemblies required without causing delay in progress of the Work.
- B. Installer Qualifications: Subcontract the glazed aluminum window wall work to a firm which is specialized in the erection of window walls and who has successfully installed work similar in design and extent to that required for the Project, in not less than three projects of similar scope to the satisfaction of the Architect, and whose work has resulted in construction with a record of successful in-service performance for a period of 10 years.
  1. The manufacturer and installer may be one and the same entity.
- C. Testing laboratories shall be specifically qualified, and AAMA accredited, to conduct laboratory and field performance tests required by these specifications and acceptable to the Owner and the Architect. The glazed window wall subcontractor's own test facilities will not be acceptable.
  1. The following laboratories are known to comply with the requirements:
    - a. Architectural Testing Inc., York, PA.
    - b. Architectural Testing Inc., Fresno, CA.
    - c. Architectural Testing Inc., Riviera Beach, FL.
    - d. Construction Research Laboratory, Inc., Miami, FL.
    - e. Construction Consulting Lab West, 4751 W State St., Suite B, Ontario, CA.
  2. Pre-Test Mockup Meeting: Prior to the start of construction of each mockup assembly at the test facility, and at the Architect's direction, meet to review methods and sequence of each mockup construction. The meeting shall include the Architect, the Contractor, and the subcontractor/system designer/manufacturer awarded the portion of the Work related to each mockup, related subcontractors, the testing and inspection agent, and any other subcontractors whose work requires coordination with this work. Include in the meeting individual foremen who will be supervising both the work of the mockups as well as the construction of the final Work on the Project.
  3. Testing: Conduct tests of each specified mockup under the direction of the Owner's Independent Testing and Inspection Agency in the presence of the Architect, the Contractor, various component manufacturers and fabricators and the Installer for each specified system to be mocked-up and tested. Proceed with each test only after acceptance of the detailed outline of test procedure.
- D. Laboratory Mockup Testing and Field Testing:

1. Laboratory Mockup Testing: Provide mockup(s) to the extent indicated on the Drawings and as specified for testing. All required mockup submittals shall have been reviewed and received final approval from the Architect prior to construction of the mockup(s).
  - a. General: Laboratory testing mockup(s) will be used as a standard for judging visual and performance acceptability of the work for the project; Then,
    - 1) Replace unsatisfactory work as directed. And,
    - 2) Provide key personnel to construct exterior wall mockup(s) who will be the same personnel who will be performing and supervising the actual work. And,
    - 3) In the event the system designer/manufacturer (single subcontract responsibility) elects to have a separate subordinate subcontractor (single subcontract responsibility) for installation and such separate subordinate subcontractor is accepted, subcontractor's supervisory and installation personnel shall be present and active participants throughout the construction and testing of the mockup(s).
    - 4) Simulate actual construction conditions as accurately as possible in every way. Provide extra materials as may be required to replace any which fail during tests. And,
    - 5) Glass used in the mockups shall be cut to the minimum tolerances expected in the final exterior wall installation.
  - b. Size: As shown but not less than the requirements of AAMA 501 and ASTM E 331 Section 8. Provide a larger mockup(s) if the proposed exterior wall details create a condition requiring a larger mockup(s) for proper evaluation and testing. Mockups shall be provided at the exterior wall testing facility complete with all glass, aluminum framing, metal panels, stone cladding, anchors, connections, flashings, sealants, and joint fillers as accepted on the mockup shop drawings. Do not take special precautions or use techniques that do not represent those to be used on the Work.
  - c. Laboratory Testing: Notify the Architect of the readiness of the mockup s for preliminary and final testing. Do not begin the testing program without the presence of the Owner's representative and the Architect.
    - 1) Preliminary Test: Conduct a single static pressure test at 50% of the maximum positive (inward) Wind Pressure (held for a minimum of 10 seconds and then released). The wall and anchoring shall be inspected for any failure. No visible signs of failure shall be allowed. Follow preliminary testing with a single test for water penetration at 50% of the pressure hereinafter specified under "Final Tests". Extraneous air leakage (tare) shall be limited to 20% or less of the allowable cubic feet per minute through each exterior wall assembly as provided under ASTM E 283 or as otherwise accepted by the Architect.
      - a) The preliminary test is purposely limited to a single event. No interim or repeat preliminary testing for Contractor benefit or correction of systems shall be permitted.

- 2) Make the following tests of the mockup(s) in accordance with the cited standards except as hereinafter modified, in the order listed, and in accordance with the specified performance criteria. Tests 1, 5, and 11 shall be conducted at a positive static pressure of 6.24 lbf/sq. ft.. Tests 2, 3, 6, 7, 12, and 13 shall be conducted at 12 lbf/sq. ft. with a water application rate of 5.0 gal./hr/s.f. for 1 cycle, maintaining the test pressure for 15 minutes.
- a) Test 1 (For Air Infiltration): ASTM E 283. Extraneous air leakage (chamber tare) shall be measured. Allowable air infiltration shall not exceed 0.06 cfm/sq. ft. of fixed wall area. The total air infiltration readings represent the amount of air through the specimen including chamber tare. Subtracting the chamber tare from the total air infiltration readings yields the net amount of air infiltration through the mockup. Dividing the mockup air leakage by the mockup area yields the air infiltration rate.
  - b) Test 2 (For Water Penetration – Uniform Static Pressure): ASTM E 331.
  - c) Test 3 (For Water Penetration – Dynamic Pressure): AAMA 501.1.
  - d) Test 4 (For Structural Performance): ASTM E 330, Procedure B, test to 0.5, and 1.0 times the wind pressure, during test. The pressure shall be held for 10 seconds at the each design wind pressure and deflection readings taken. Deflection readings shall be taken at end connections and midspans of main framing members, at intersections of framing members and at midspans of glass holding members, glass and panels. Readings shall be taken for both positive and negative loading. If failure occurs through glass breakage prior to achieving 1.0 times the maximum wind pressure, replace glass and repeat test. Two successive failures of the same light or panel not otherwise attributable to inherent glass defects (i.e., frame deflections imposing localized pressure on glass panel that causes glass failure) will be considered unacceptable. Further tests shall be suspended until deficiencies are corrected, which may include increasing the stiffness of glass holding members and/or adjustment of the glazing details.
  - e) Test 5 (Retest for Air Infiltration): ASTM E 283. Repeat Test 1 as stated above.
  - f) Test 6 (Retest for Water Penetration – Uniform Static Pressure): ASTM E 331. Repeat Test 2 as stated above.
  - g) Test 7 (For Water Penetration – Dynamic Pressure): AAMA 501.1. Repeat Test 3 as stated above.
  - h) Test 8 (For Seismic Performance): AAMA 501.4. Test for seismic performance by applying lateral forces to the frame supporting the mockup specimen. Apply loading displacements in the directions and for the duration as required by the project's structural engineer. Visually inspect mockup specimen after each displacement. There shall be no failure or gross permanent distortion of anchors, frame, glass, or panels. Structural silicone shall not experience adhesive or cohesive failure along any glass, frame, or panel edge. Glazing gaskets may not disengage and weather seals may not fail.

- i) Test 9 (For Live Load Deflection Performance): AAMA 501.7. Test for live load deflection by applying vertical load to the frame supporting the mockup specimen, so as to induce a deflection in the mockup equivalent to the live load deflection identified on the drawings at the location the mockup is simulating. The load shall be applied and released through 10 cycles. Visually inspect mockup specimen after each displacement.
  - j) Test 10 (For Thermal Cycling): At the completion of Test 9, provide an internal enclosure (chamber) within the mockup as required to satisfy the project specific requirements and the requirements of Test Method for Thermal Cycling of Exterior Walls AAMA 501.5. The exterior and interior temperatures to be used in the test procedure shall be as specified herein. Test the wall assembly for a minimum of 3 thermal cycles each maintained for two hours. Components used within the system shall withstand thermal movements without buckling, distortion, cracking, failure of glass, or failure of joint seals or undue stress on the finished surfaces, materials, or fixing assemblies.
  - k) Test 11 (Retest for Air Infiltration): ASTM E 283. Repeat Test 1 as stated above.
  - l) Test 12 (Retest for Water Penetration – Uniform Static Pressure): ASTM E 331. Repeat Test 2 as stated above.
  - m) Test 13 (For Water Penetration – Dynamic Pressure): AAMA 501.1. Repeat Test 3 as stated above.
  - n) Test 14 (For Structural Performance): ASTM E 330, Procedure B, except conduct test to 1.5 times the maximum wind pressure. Record pressures and deflections at 1.5 times the wind pressure, during test.
- d. Corrective Measures: Correct any deficiencies in the mockups observed during testing and repeat tests as may be required to show compliance with the performance standards. Deficiencies requiring repair or modification to the mockup(s) shall mandate a complete retesting of the mockup(s) beginning with the specified Preliminary Test unless otherwise directed by the Architect. If compliance with the performance standards is not achieved after two complete retests the Contractor shall bear all costs for additional retesting until compliance with the performance standards is accomplished. Incorporate corrective measures indicated by the test report into the final exterior wall assemblies after review by the Architect.
2. Field Testing: Test the window wall, and punched opening window, sample installations erected to the opaque portions of the exterior wall cladding in accordance with the specified field test methods. Conduct tests of each specified sample installation under the direction of the testing laboratory in the presence of the Owner, Architect, the Contractor, various component manufacturers and fabricators and the installer for each specified system incorporated in the sample installations.
- a. Field Test for Water Leakage (Chamber Testing):
    - 1) Water Spray Test with Static Air Pressure Difference: ASTM E 1105 and AAMA 503 conducted at a Uniform Static Test Pressure of 12 lbf/sq. ft..

- 2) Correct all deficiencies observed as a result of this test and retest. For each unsuccessful field test, another similar sample installation area shall be selected and tested. Any repairs or remediation conducted to pass a test, if they constitute a change to the design (e.g., sealing of a joint that was previously open, or adding a weep hole) must be implemented throughout the work. Any remedial repairs which increase the maintenance requirements of the system (i.e., face sealing of a drained system), will not be accepted.
- b. Field Test for Water Leakage (Hose Stream Testing):
    - 1) Water Spray Test without Static Air Pressure Difference: AAMA 501.2.
    - 2) Correct all deficiencies observed as a result of this test and retest. For each unsuccessful field test, another similar sample installation area shall be selected and tested. Any repairs or remediation conducted to pass a test, if they constitute a change to the design (e.g., sealing of a joint that was previously open, or adding a weep hole) must be implemented throughout the work. Any remedial repairs which increase the maintenance requirements of the system (i.e., face sealing of a drained system), will not be accepted.
  - c. Field Test for Air Leakage: This test shall only be conducted on the punched opening and window wall sample installations.
    - 1) Air Infiltration: ASTM E 783 and AAMA 503 conducted at a Uniform Static Test Pressure of 6.24 lbf/sq. ft..
    - 2) Correct all deficiencies observed as a result of this test and retest. For each unsuccessful field test, another similar sample installation area shall be selected and tested. Any repairs or remediation conducted to pass a test, if they constitute a change to the design (e.g., sealing of a joint that was previously open, or adding a weep hole) must be implemented throughout the work. Any remedial repairs which increase the maintenance requirements of the system (i.e., face sealing of a drained system) will not be accepted.
- E. Pre-Construction Sealant Compatibility and Adhesion Testing: Test results confirming compatibility and adhesion are mandatory for all concealed and exposed sealant materials in contact with exterior glazing, stone, precast, other sealants, flashings, metal framing, and shims prior to full size sample installation construction. Refer to Section 07 92 00 "Joint Sealants" for specific testing requirements, and anticipated lead-time necessary to perform testing.
- F. Standards: Comply with the applicable provisions and recommendations of the following standards below, where standards conflict the more stringent shall apply:
1. Aluminum Association (AA):
    - a. No. 1 "Aluminum Standards and Data."
    - b. "The Aluminum Design Manual, Specifications and Guidelines for Aluminum Structures, Allowable Stress Design, Latest Edition."

2. American Architectural Manufacturers Association (AAMA):
  - a. AAMA "Metal Curtain Wall Manual."
  - b. AAMA "Aluminum Curtain Wall Design Guide Manual," Volumes 1-9.
  - c. AAMA "Curtain Wall Manual #10."
  - d. AAMA "Aluminum Store Front and Entrance Design Guide Manual."
  - e. AAMA 501.1, "Specification for Method of Test for Metal Curtain Walls for Water Penetration Using Dynamic Pressure."
  - f. AAMA 501.2, "Specification for Field Check of Metal Curtain Walls for Water Leakage."
  - g. AAMA 501.4, "Recommended Static Testing Method for Evaluating Curtain Wall and Storefront Systems Subjected to Seismic and Wind Induced Inter-story Drift."
  - h. AAMA 501.5, "Test Method for Thermal Cycling of Exterior Walls."
  - i. AAMA 1801, "Acoustical Rating of Windows, Doors, and Glazed Wall Sections."
  - j. AAMA 501.7, "Recommended Static Testing Method for Evaluating Windows, Window Wall, Curtain Wall and Storefront Systems Subjected to Vertical Inter-story Movements."
  - k. AAMA 503, "Field Testing of Metal Store Fronts, Curtain Walls and Sloped Glazing Systems."
  - l. AAMA 611, "Anodized Architectural Aluminum."
  - m. AAMA 1801, "Acoustical Rating of Windows, Doors, and Glazed Wall Sections."
  - n. AAMA 2603, "Voluntary Performance Requirements and Test Procedures for Pigmented Organic Coatings on Extruded Aluminum."
  - o. AAMA 2605, "Specification for Superior Performing Organic Coatings on Architectural Extrusions and Panels."
  - p. AAMA TIR-A8, "Structural Performance Poured and Debridged Framing Systems."
  - q. AAMA TIR-A9-2014, "Design Guide for Metal Cladding Fasteners."
  - r. AAMA QAG-1, "Quality Assurance Processing & Monitoring Guide for Poured and Debridged Polyurethane Thermal Barriers."
  - s. AAMA QAG-2, "Quality Assurance Processing & Monitoring Guide for Polyamide Thermal Barriers."
3. American Institute of Steel Construction (AISC), "Steel Construction Manual," Current Edition.
4. American Society for Testing and Materials (ASTM):
  - a. ASTM C 1401, "Standard Guide for Structural Sealant Glazing."
  - b. ASTM E 283, "Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences Across the Specimen."
  - c. ASTM E 330, "Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference."
  - d. ASTM E 331, "Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference."
  - e. ASTM E 783, "Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors."



- f. ASTM E 1105, "Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform or Cyclic Static Air Pressure Difference."
  - g. ASTM E 1300, "Standard Practice for Determining Load Resistance of Glass in Buildings."
  - h. ASTM E 1886, "Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials."
  - i. ASTM E 1996, "Standard for Performance of Exterior Windows, Glazed Curtain Walls, Doors and Storm Shutters Impacted by Windborne Debris in Hurricanes."
5. National Association of Architectural Metal Manufacturers (NAAMM), "Metal Finishes Manual."
  6. Steel Structures Painting Council (SSPC): "Steel Structures Painting Manual, Vol. 2, Systems and Specifications."
  7. ANSI Z97.1 and Federal Standard 16 CFR 1201, Consumer Product Safety Commission (CPSC): "Safety Standard for Architectural Glazing Materials," as published in the Code of Federal Regulations (CFR). Comply with the applicable requirements of the laws, codes, ordinances and regulations of Federal and Municipal authorities having jurisdiction, wherever requirements conflict the more stringent shall be required. Obtain approvals from all such authorities. As a minimum provide safety glazing complying with ANSI Z97.1 for Category A performance and testing requirements of 16 CFR Part 1201 for Category II performance.
  8. Welding Standards: Welding shall be performed by skilled and qualified mechanics. Welding shall be performed in accordance with the applicable provisions of AWS D1.1 "Structural Welding Code - Steel" and AWS D1.2, "Structural Welding Code--Aluminum."
  9. Builders Hardware Manufacturers Association (BHMA):
    - a. ANSI/BHMA A156.10, "Power Operated Pedestrian Doors."
    - b. ANSI/BHMA A156.19, "Power Assist and Low Energy Power Operated Doors."
    - c. ANSI/BHMA A156.27, "Power and Manual Operated Revolving Pedestrian Doors."
  10. Underwriters Laboratories (UL): Provide power door operators that comply with UL 325.
  11. National Fenestration Rating Council (NFRC):
    - a. NFRC 100, "Procedure for Determining Fenestration Product U-Factors."
    - b. NFRC 200, "Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence."
    - c. NFRC 300, "Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems."
- G. Regulatory Requirements: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and 2019 California Building Code.
- H. Sample Installations: After the construction and acceptance of testing mockup(s), construct sample installations of the final exterior wall assemblies where shown on the Drawings.

1. General: Sample installations will be used as a standard for judging acceptability of work for the Project. Replace unsatisfactory work as directed. Maintain sample installations during construction as a standard for judging acceptability of the exterior wall work. Properly finished, maintained, and performing sample installations shall be retained as a portion of the completed work.
  2. Size: Provide full sized sample installations to the extent indicated on the Drawings, or if not indicated, as directed by the Architect. Sample installations shall be built on site complete with all glass, aluminum framing, adjacent cladding materials, anchors, connections, flashings, sealants, and joint fillers as accepted on the final shop drawings. Do not take special precautions or use techniques that do not represent those to be used on the work. Do not enclose the interior side of the wall with interior finishes and insulation materials.
- I. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Prior to the start of the window wall work, and at the Contractor's direction, meet at the site and review the construction schedule, availability of materials, installers personnel qualifications, equipment and facilities needed to make progress and avoid delays, installation procedures, testing, inspecting, and certification procedures, and coordination with other work. Meeting shall include Contractor, Owner, window wall installer, sealant installer, as well as any other subcontractors or material technical service representatives whose work, or products, must be coordinated with the window wall work.

#### **1.4 IDENTIFICATION, DELIVERY, STORAGE, AND HANDLING**

- A. General: Comply with the applicable provisions of AAMA "Curtain Wall Manual #10" for the care and handling of window wall work from shop to site.
- B. All components of the window wall work shall be identified after fabrication by marks clearly indicating their location in the building. Packaging of components shall be so selected to protect the components from damage during shipping and handling.
- C. Storage on Site:
  1. Store window wall components in a location and in a manner to avoid damage to the components. Stacking shall be done in a way that will prevent bending, excessive pressure, abrasion or other permanent damage of the component and its finished surfaces.
  2. Store window wall components and materials in a clean, dry location, away from uncured concrete, masonry work, sprayed on fireproofing work, and other construction activities. Cover with non-staining waterproof paper, tarpaulin, or polyethylene sheeting in a manner that will permit circulation of air inside the covering.
- D. Keep handling on site to a minimum. Exercise particular care to avoid damage to finishes of metals.

## 1.5 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of supporting structure by field measurements before fabrication so that the window wall work will be accurately designed, fabricated and fitted to the structure. Indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work. Use Contractor's lines and benchmarks as a basis for measurements.
- B. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to, power supplies, fire alarm system and detection devices, access control system, security system, building control system.

## 1.6 WARRANTY

- A. Special Warranty: Submit a 2-year written warranty, beginning from date of substantial completion, and executed by the Contractor, manufacturer and the window wall installer agreeing to repair or replace components of window wall systems that develop defects in materials or workmanship, design and engineering, within the specified warranty period. Defects include, structural failures, sealant failures, deterioration of metals, metal finishes, and other materials beyond normal weathering, failure of operating components to function properly, uncontrolled water leakage, uncontrolled air leakage, and any other evidence of failure or deterioration of the window wall work to meet performance requirements.
- B. Warranty, High Performance Organic Coatings: Submit a warranty for a period of 5 years, warranting the integrity of film and permanence of color of the high performance organic coatings for the following:
  - 1. Color fade not to exceed 5 delta E units (Hunter) as calculated in accordance with ASTM D 2244 on exposed surfaces cleaned with clean water and a soft cloth.
  - 2. Degree of chalking not to exceed rating No. 8 when measured in accordance with ASTM D 4214 on exposed unwashed surfaces.
  - 3. Will not crack, check or peel.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis of Design and Permit Approval Products: The drawings and specifications are based on the T-500 Series, OPG-3000 (2-1/4-inch x 10-inch profile) system, manufactured by Arcadia Manufacturing.
- B. Shop Drawings, prepared by engineers engaged by the Basis of Design manufacturer, are incorporated into the Contract Drawings. The intent of this process is that the Shop Drawings and calculations provided by the manufacturer are part of the documents approved by DSA for permitting and construction.

1. Substitutions: See Section 01 25 00-Substitution Procedures.
  2. Deferred Submittals: In addition to the requirements of Section 01 25 00, proposed substitutions to the Basis of Design system will require preparation of Deferred Submittal documentation, for review and approval by DSA. Contractor is required to allow sufficient time in the schedule for preparation of Deferred Submittal documentation, review by Architect and consultants, and DSA review, including corrections and back check.
    - a. Failure to do so will not justify delays or extensions of time.
    - b. Should acceptance of a substitution require significant revisions to the Contract Documents, Architect reserves the right to request Additional Services compensation for updating the Contract Documents.
- C. Source Limitations: Obtain window walls from single source from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. General: Provide glazed aluminum window wall systems meeting or exceeding the following performance requirements:
1. Structural Properties:
    - a. Wind Loads: The glazed aluminum window wall work, including glass, shall be designed, fabricated and installed to withstand the maximum inward and outward wind pressures as indicated on Drawings.
    - b. Seismic Loads: As indicated on Drawings.
      - 1) Provide miscellaneous steel framing not shown on drawings which is required to satisfy seismic criteria.
    - c. Deflection Limitations:
      - 1) Deflections: Base calculations for the following deflections upon the combination of maximum direct wind loads, building deflections, thermal stresses, and erection tolerances.
        - a) The deflection of the framing members for each unit of glass in a direction normal to the plane of the wall when subjected to the full code required wind loads indicated above shall not exceed 1/175 of the glass edge length or 3/4 inch whichever is less, except limit deflection of glass to 1 inch for exterior walls.
        - b) Glass, sealants and interior finishes shall not be included to contribute to framing member strength, stiffness or lateral stability.
        - c) Cantilever Deflection: The deflection of a framing member overhanging an anchor point shall be limited to  $2L/175$  where L is the length of the cantilevered member.

- d) Soffit framing shall be fabricated and installed to resist its own deadloads and upward and downward windloading with a deflection not to exceed  $1/360$  of the distance between supports.
  - e) The net deflection of metal wall panels in a direction normal to the plane of the wall when subjected to the maximum inward and outward wind pressures shall not exceed  $1/60$  of the panel's short length span. Deflection shall be measured relative to horizontal and vertical support members with allowable deflection determined by the lesser dimension.
  - f) In addition to the above deflections, stone supporting aluminum framing members shall be limited to  $1/600$  parallel and perpendicular to the wall plane, with rotation of continuous member on kerfed stone limited to a maximum of  $1/16$  inch.
- 2) Do not permit any permanent deformation (set) in the metal framing work. Permanent deformation, fastener, weld, or gasket failure, component breakage or disengagement shall not occur under wind loading equal to 1.5 times the wind loads (positive or negative). Permanent deformation shall be taken as deflection without recovery exceeding  $1/1000$  times span.
- d. Dead Loads:
- 1) Maximum full deadload deflections, parallel (in-plane) to wall plane, of framing members shall not reduce glass bite or glass coverage, to less than 75 percent of the design dimension, and shall not reduce edge clearance to less than 25 percent of design dimension or  $1/8$  inch whichever is greater.
  - 2) Limit deflections of metal members spanning door openings to  $1/300$ . The clearance between the member and an operable door shall be no less than  $1/16$  inch.
  - 3) Twisting (rotation) of the horizontals due to the weight of the glass shall not exceed 1 degree, measured between ends and center of each span.
- e. Uniform Structural Loads: Recent satisfactory uniform wind loading tests, acceptable to the Architect, of each glazed window wall assembly (each window, window wall, entrance and storefront) shall have been conducted in accordance with the requirements of ASTM E 330 . Each assembly shall have been subjected to inward and outward acting uniform loads equal to 0.5, 1.0 and 1.5 times the inward and outward acting design wind loads specified above under paragraph 'wind loads.' Satisfactory performance at these loads shall mean no glass or other component breakage, component disengagement, and no permanent deformation of main framing members in excess of the permanent deformation criteria specified above. The qualification of 'recent' test results is to limit the glazed window wall assemblies being provided for the project to only those which have been tested within the last seven years and under conditions similar to the project requirements.
- 1) In the absence of satisfactory test results a full scale laboratory mock up and testing program shall be required and conducted to the extent specified herein.

- f. Uniform Structural Loads: Conduct uniform wind loading tests of each testing laboratory mockup assembly indicated on the drawings in accordance with the requirements of ASTM E 330. Each window, and window wall assembly shall be subjected to inward and outward acting uniform loads equal to 1.5 times the inward and outward acting design wind loads specified above under paragraph 'wind loads.' After testing, the testing laboratory mockups shall be considered to have passed the uniform structural load testing if no glass or other component breakage, component disengagement, and no permanent deformation of main framing members in excess of the permanent deformation criteria specified above was observed or recorded.
- g. Operational (Traffic) Loads: Design and fabricate entrances to withstand the operating loads which result from heavy traffic conditions using the specified hardware, without measurable permanent deflection. Limit elastic deflections so as to provide the normal degree of rigidity required to avoid glass breakage, air leaks and other objectionable results of excessive flexibility. Provide weatherstripping at stiles, sill and head rails of door leaves, to minimize air, water and sound leaks.
  - 1) Accommodate seismic movement as required by local code authorities to maintain exit doors in operable condition in case of seismic event.

B. Air Leakage:

- 1. Typical Conditions: Air leakage through each glazed aluminum window wall assembly shall not have exceeded 0.06 cfm/sq. ft. of fixed wall area when tested in accordance with ASTM E 283 at a static-air-pressure difference of 6.24 lbf/sq. ft.
- 2. Swinging Doors: Air leakage through each swinging and revolving entrance door shall not have exceeded 1.0 cfm/sq. ft. of surface area when tested in accordance with ASTM E 283 at a static-air-pressure difference of 1.57 lbf/sq. ft. with the door leaves in the closed position and the revolving door wings in the closed cross position

C. Water Penetration:

- 1. Water penetration in this specification is defined as the appearance of uncontrolled water, other than condensation, on any indoor face of any part of the wall.
- 2. Provision shall be made to drain to the exterior face of the wall any water entering the system.
- 3. No uncontrolled water penetration shall have occurred when each glazed aluminum window wall assembly (each fixed window, window wall, and storefront wall) was tested in accordance with the ASTM E 331 for one 15 minute cycle at a static pressure difference of 12 lbf/sq. ft. minimum.

D. Thermal Movements: Fabricate the glazed aluminum window wall work to accommodate for such expansion and contraction of component materials, and supporting elements, as will be caused by surface temperatures ranging from -5 to +180 deg F, without causing noise, buckling, glass breakage, failure of joint sealants, undue stress on metal members and fasteners, failure of operating units to function properly, reduction of performance, and other detrimental effects.

1. Dimensions shown on Drawings are based on an assumed design temperature of +70 deg F. Fabrication and erection procedures shall take into account the ambient temperature range at the time of the respective operations.
  2. Shadow Boxes: Shadow boxes shall be designed for an exposed surface metal temperature range of -5 to +235 deg F.
- E. Building Frame Movement: Design, fabricate and install glazed aluminum window walls to withstand building movements including thermal movements, loading deflections, shrinkage, creep and similar movements without glass breakage, anchor failures, or structural damage. Thermal movements shall be as specified above. Building frame deflections, shrinkage, creep and other movements are available from the structural engineer.
1. Comply with the pass/fail performance criteria of AAMA 501.4 for the project specific building occupancy type for building frame movements caused by seismic and wind induced inter-story drifting.
- F. Condensation Resistance: Design, fabricate and install the window wall systems to prevent excessive condensation on the indoor exposure of the wall with the mechanical system functioning under normal operating conditions. A computer generated thermal analysis (for each primary window wall system; showing temperature gradients through each component of the glazed aluminum window wall and the location of the dewpoint shall be submitted with the shop drawing package. Excessive condensation is defined as the accumulation of uncontrolled condensate flowing from the window wall at any location, or visible ice, frost, or water on more than 5 percent of the area of any module of the exterior wall.
- G. Thermal Transmittance: Design, fabricate and install the aluminum window wall assemblies with the assembly U-factor maximum to comply with ASHRAE 90.1 and the IECC for the project specific geographic location of the building project when tested according to NFRC 100. A computer generated thermal analysis for each primary window wall system showing temperature gradients through each component of the window wall and the location of the dewpoint shall be submitted with the shop drawing package. Indoor humidity, and indoor and outdoor temperature parameters for the project are available from the mechanical engineer.
- H. Glass Statistical Factor: Glass thicknesses when shown on the drawings, or specified, are for convenience of detailing only and are to be confirmed by the Contractor and/or glass manufacturer. All glass for the size openings shown will be provided in thicknesses such that the probability of breakage at the design "Wind Load" will not exceed 8 lights per 1000 lights (S.F. 2.5) based on a 3 second gust wind load duration, and reflectance and shading indicated. The glass manufacturer shall provide, on request, substantiating glass breakage data if such data is not otherwise available as manufacturer's published data.
1. The nominal glass thickness permitted shall be 6.0 mm.
  2. All exterior glass shall be assumed to be non-vented due to the use of interior sun screening devices such as shades and horizontal venetian blinds.
- I. Sound Transmission: Design, fabricate and install exterior windows, doors, and glazed wall sections with a minimum outdoor-indoor transmission class (OITC) of 26 according to ASTM E 90, ASTM E 1425, or AAMA 1801 with ratings derived from ASTM E 413 and ASTM E 1332.

- J. Glazing System Design: Exterior wall interior glazing channel dimensions, shall be sized to provide bite on glass, minimum edge and face clearances, with reasonable tolerances, and to receive both dry gaskets, and recessed 2 and 4-side structural silicone beads that are below the sill, head, and jamb framing sight lines.
- K. Structural-Sealant Glazing: Comply with ASTM C 1401 for design and installation of 2 and 4 side structurally glazed window wall assemblies.
- L. Design Modifications:
  - 1. Submit design modifications necessary to meet the performance requirements and field coordination.
  - 2. Variations in details or materials shall not adversely affect the appearance, durability or strength of components, nor shall such variations cause excessive stress, or deflections, to the building structural frame.
  - 3. Maintain the general design concept without altering size of members, profiles and alignment.

## 2.3 MATERIALS

- A. Aluminum: Conform to the requirements published in AA "Aluminum Standards and Data", referenced ASTM standards and the following. All aluminum extrusions shall be manufactured to dimensional tolerances so as to eliminate edge projection or misalignment at joints. Unless otherwise specified, provide alloy and temper as required to suit performance requirements and finish(es) indicated. Provide concealed extruded bars, rods, shapes and tubes in alloys as recommended by the fabricator to join or reinforce assembly of exposed aluminum components.
  - 1. Alloys:
    - a. Sheet and Plate: Alloy 5005 and ASTM B 209.'
    - b. Extruded Bars, Rods, Shapes, and Tubes: Alloy 6063 and ASTM B 221, 'Anodizing Quality.'
    - c. Bars, Rods, and Wire: ASTM B 211.
  - 2. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
  - 3. Shapes and Thickness: Provide shapes as shown and as required to suit the performance requirements.
  - 4. Shapes and Thickness: Provide shapes as shown and as required to suit the performance requirements but with wall thickness of not less than the following:
    - a. Minimum Wall Thickness for Structural Extrusions: 1/8 inch.
    - b. Minimum Wall Thickness for Non-Structural Extrusions: 1/16 inch.
- B. Carbon Steel: For carbon steel components required to join, reinforce or support the assembly of aluminum components provide carbon steel conforming to ASTM A 36/A 36M for structural shapes, plates, and bars; ASTM A 1008/A 1008M for cold-rolled sheet and strip; or ASTM A 1011/A 1011M for hot-rolled sheet and strip; ASTM A 500 or ASTM A 501 for steel tubing.



1. Refer to Section 05 50 00, Metal Fabrications, for carbon steel framing, embedments, anchors, and welding that is not primary building structure nor furnished by the window wall fabricator but is required to transmit live and deadloads from the window wall framing to the primary building structure.
- C. Anchors and Fasteners:
1. Material:
    - a. Wet Zones: Series 300 stainless steel.
    - b. Dry Zones: Carbon steel complying with either ASTM F 3125 or SAE Grade 5.
  2. Anchor and Fastener Metal Alloy Types, Designations and Standards: Alloys as selected by fabricator to prevent corrosion resistance with the components fastened. Do not use self-drilling, self-tapping type fasteners.
  3. Where fasteners are subject to loosening or turn out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
- D. Cast-In-Place Concrete Inserts: Anchor channel type, with filler strips, manufactured from formed hot or cold rolled carbon steel channels with flange edges returned toward web, having a minimum of two (2) stud, or I, anchors shop welded to the back of each channel, complying with ASTM A 570. Provide channels, bolts, washers, and shims hot-dip galvanized per ASTM A 153/A 153M. Width, depth, and metal thickness as required to suit performance requirements.
- E. Concealed Flashing: Dead-soft, 0.018 inch thick stainless steel, complying with ASTM A 666, Type 304.
- F. Door Hardware: Refer to Section 08 71 00 "Door Hardware."

## 2.4 SEALING, GLASS AND GLAZING MATERIALS

- A. Concealed Sealing Materials: All sealing materials concealed within the glazed aluminum window walls (i.e. glass pockets, end dams, fastener heads, and internal gutters) shall be silicone, compatible with and adherent to each material it will be in contact with, as recommended by the manufacturer to fulfill performance requirements.
- B. Exposed Sealing Materials: All sealing materials exposed at glazed aluminum window wall perimeter joints in contact with adjacent cladding materials: Silicone, refer to Section 07 92 00 "Joint Sealants."
- C. Glass and Glazing Materials: Refer to Section 08 80 00 "Glazing."

## 2.5 OTHER GLAZED ALUMINUM WINDOW WALL COMPONENTS

- A. Condensate Gutters: Provide shop fabricated (preformed) extruded aluminum units of the type, size, and profiles required to form a complete and continuous waterproof and weatherproof gutter system complete with prefabricated corner units, expansion joints, and anchoring devices.
- B. Shadow Box Metal Back Panels: Custom fabricate metal back panels of shadow box enclosures from minimum 0.08 inch thick, ASTM B 209, aluminum sheet metal. Assemble back panels to accommodate expansion and contraction. Oil canning shall not be permitted in metal back panels; in addition, metal back panel anchorage devices (if any), stiffeners (if any), and reinforcements shall not be visible in the finished (exposed) faces of metal back panels. After forming metal back panels, but before finishing, remove abrasions, scratches, die markings, and dents. Finish exposed surfaces of metal back panels using coating and a color to match the exterior snap caps of the window wall framing system. Provide metal back panels with an interior air seal that is concealed from view from building exterior. If interior air seal utilizes tapes, seals, or gaskets, use types that will not release volatiles, nor leave visible deposits or residues on inside of spandrel glass unit or metal back panel.
- C. Thermal Break Construction: Fabricate window walls with an integrally concealed, poured in place, urethane thermal break, located between extrusions exposed to the exterior or contacting exterior finish materials and window members exposed on the interior or contacting interior finish materials, in a manner which eliminates direct metal to metal contact between exterior and interior metal components of the window wall assemblies. Provide thermal breaks of low thermal conductive materials, which satisfy the performance requirements. Urethane material for thermal breaks shall have been designed for window, window wall, and curtain wall construction and have been tested to demonstrate resistance to thermal conductance and condensation. Urethane materials shall be selected which have been in successful use for a minimum of 5 years. All thermal breaks shall be formed under typical plant conditions in extrusions designed for the project and tested to confirm that the product will meet or exceed the performance requirements.
- D. Slip and Separator Gaskets:
1. Bolted Slip Joints: Non-metallic, low friction material bearing temperature and moisture resistances and low abrasion properties as required to suit performance requirements.
  2. Non-Bolted Slip Joints: Non-corrosive, non-toxic impregnated felt, or butyl tape with a pressure sensitive adhesive on one surface that is formulated for proper adhesion to metals indicated; gasket shall bear temperature and moisture resistance properties as required to suit performance criteria; thickness and width as required.
- E. Baffle Material: Reticulated foam baffle material with a pore count (ppi) as required by assembly fabricator to suit performance requirements.
- F. Insulation: Foil-faced, slag-wool-/rock-wool-fiber rigid board insulation for window walls; refer to Section 07 21 00 "Thermal Insulation" for insulation to be used in glazed window wall assemblies.

- G. Snap In Sealant Stops: Provide rigid PVC sealant stops of profile and hardness as recommended by the window fabricator, and fabricated to a cross sectional profile to interlock with aluminum extrusions at all window perimeters.
- H. Window Sill Extensions: Thickness to match non-structural extrusions, profiles as indicated on the Drawings.

## 2.6 FABRICATION

- A. General: Fabricate the glazed aluminum window walls to the designs, shapes, and sizes shown using the materials specified and shown to produce assemblies that meet or exceed the performance requirements. To the greatest extent possible complete fabrication, assembly, finishing, hardware applications and other work before shipment to Project site.
- B. Joints in Metal Work: All exposed work shall be carefully fitted and matched to produce continuity of line and design, with all joints, being accurately fitted for hairline contact and rigidly secured. Where additional rigidity or strength is required to satisfy the performance requirements reinforce window wall components with aluminum or carbon steel shapes, bars, and plates.
- C. Shop Assembly: As far as practicable, all fitting and assembly work shall be done in a fabrication shop.
  - 1. Framing members attaching window wall components to building supports shall provide for adjustment to accommodate fabrication and construction tolerances, and allow for thermal and building movements.
  - 2. Provide vents, weepholes and internal water passages in the glazing framing recesses as recommended by the respective glass and framing manufacturers to conduct infiltrating water to the exterior, and to avoid condensation at glass spandrel unit air spaces. Provide weep baffles secured to inside of frame behind vents and weepholes.
  - 3. At shadow box enclosures provide vents, weepholes and internal water passages in the glazing framing recesses from the shadow box interior space to outside air to conduct infiltrating water to the exterior, and to avoid condensation within the interior air space between the glass spandrel unit and the shadowbox enclosure. Provide weep baffles secured to inside of frame behind vents and weepholes.
  - 4. Provide flush endcaps for all mullion extension cap extrusions.
  - 5. Provisions for reglazing from interior for vision glass and exterior for spandrel glazing or panels.
- D. Door Stile and Rail Dimensions:
  - 1. Bottomrails: Provide minimum 10 inch (254 mm) high one piece bottomrail unless otherwise indicated on the Drawings.
  - 2. Stiles and Top Rail Dimensions: As indicated on Drawings.
  - 3. Door Thickness: 1-3/4 inch (44.5 mm).
  - 4. Preglaze door units to greatest extent possible, in coordination with installation and hardware requirements. Glazing, whether in factory or in field, shall be performed in accordance with Section 08 80 00 "Glazing."

5. Fabricate all doors and frames to accommodate the swing direction shown.
- E. Provide extruded aluminum entrance door inserts at door frames designed with bosses sized to receive selected door gasket.
- F. Exposed Fasteners: Not permitted.
- G. Protection of Metals: Wherever dissimilar metals are in contact, except in the case of aluminum in contact with galvanized steel, zinc, separate such surfaces with a coating of zinc rich primer, bituminous paint, or separation gaskets as the condition requires. Wherever aluminum comes in contact with concrete surfaces separate such surfaces with a coating of zinc rich primer, bituminous paint, or separation gaskets as the condition requires.
- H. Welding: Complete the welding of exposed surfaces prior to finishing.
  1. All welding shall be in accordance with the recommendations of the AWS and shall be performed with electrodes and/or by methods recommended by suppliers of the metal being welded. Fabricate welded aluminum assemblies so that fraying surfaces are free rinsing and will not trap coating solutions.
  2. Welds behind finished surfaces shall be so performed as to eliminate distortion, and discoloration, on the finished side. Plug, puddle, and spot welding are not permitted. Provide low heat filled welds using a chill bar on finished side to eliminate dimpling, distortion, and/or discoloration on the finished side. If weld heads appear on the finished surface, the weld head shall be ground, and polished to match and blend with the finish on adjacent parent metal. Weld spatter and welding oxides on finished surfaces shall be removed immediately.
  3. At joints where welding cannot be performed use concealed stainless steel fasteners to join assembly.
- I. Shop Painting of Carbon Steel: Ungalvanized steel items shall be thoroughly cleaned of all loose scale, filings, dirt, and other foreign matter, in accordance with SSPC SP3 "Power Tool Clean," and painted with coating as specified for carbon steel surfaces.

## 2.7 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish Application:
  1. Apply high performance organic coatings to all exposed exterior surfaces of glazed aluminum window wall components. Apply thermosetting acrylic enamel coatings to all exposed interior surfaces of glazed aluminum window wall components.
  2. Apply anodized coatings to all exposed surfaces of glazed aluminum window wall components.
  3. Adhesion and Compatibility Testing: Test samples of aluminum coatings on aluminum will be required for compatibility and adhesion testing of all sealants proposed for use on framing components. Refer to Section 07 92 00 "Joint Sealants."

- C. Appearance of Finished Work: During production, maintain large size color range samples for use in comparing against production material. Variations in appearance of abutting or adjacent pieces are acceptable if they are within the range of approved samples. Noticeable variations in the same piece are not acceptable.
- D. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
- E. High-Performance Organic Coating Finish: AA-C12C42R1x and the following:
  - 1. Polyvinylidene fluoride finish coating containing not less than 70 percent of "Kynar 500" or "Hylar 5000" fluorocarbon resin specially formulated for spray application to extrusions and preformed aluminum metal shapes. Coating films shall be uniform and visibly free from flow lines, streaks, blisters, sags or other surface imperfections in the dry-film state on all surfaces.
    - a. Metal Preparation and Pretreatment: Pretreatment of aluminum surface and application of the finish shall be performed under specifications issued by the licensed formulator to approved applicator and the following as a minimum:
      - 1) The products used to form the chemical conversion coating on aluminum extrusions shall conform with ASTM D 1730, Type B, Method 5 (Amorphous Chromium Phosphate Treatment), Method 7 (Amorphous Chromate Treatment), or Trivalent Chrome Treatment.
        - a) All aluminum framing surfaces indicated to receive structural glazing compounds shall be amorphous chromate phosphate wash-coat pretreatment; (a.k.a. Alodine treated) as a minimum; mill finishes are prohibited.
      - 2) The coating weight of the chemical conversion coating shall be a minimum of 40 mg. per ft.<sup>2</sup> on exposed surfaces as specified in ASTM B 449, Section 6, Class I. Processing shall conform with that specified in ASTM B 449, Section 5.
    - b. Thickness:
      - 1) Fluoropolymer 2-Coat Coating System: Minimum 1.2 mil total dry film thickness (0.25 mil primer +/- 0.05 mil and 1.0 mil topcoat).
    - c. Manufacturer, Coating System:
      - 1) Two Coat, Mica Flake System; one of the following:
        - a) PPG Paints; Duranar Sunstorm.
        - b) Sherwin-Williams (formally Valspar, Inc.); Fluorpon Classic II.

## 2.8 COATINGS FOR CONCEALED METAL SURFACES

- A. General: The following protective coatings shall be applied to surfaces of metals which are to be concealed in the construction:
1. Coating for Carbon Steel: Hot dip galvanized, complying with ASTM A 123.
  2. Coating for Aluminum, and Carbon Steel: Where aluminum or carbon steel surfaces are to be in contact with each other or in contact with dissimilar materials such as masonry or concrete, and where hot dip galvanizing of carbon steel is incompatible with component parts because of galvanic action or component fabrication tolerances provide one of the following:
    - a. Bituminous Paint: Cold-applied, non-sagging, bituminous paint complying with ASTM D 1187. Apply in two coats for an overall minimum dry film thickness of 25 mils.
    - b. Zinc Rich Primer: Organic zinc-rich primer, complying with SSPC-Paint 20.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Coordinate glazed aluminum window wall work with the work of other Sections and provide items to be placed during the installation of other work at the proper time to avoid delays in the work.
- B. Place such items, including concealed overhead framing, accurately in relation to the final location of glazed aluminum window wall components.

### 3.2 EXAMINATION

- A. Examine the substrates, adjoining construction, and conditions under which the Work is to be installed. Proceed with installation only after unsatisfactory conditions have been corrected.
1. Before beginning installation of the glazed aluminum window wall work examine all parts of the existing building structural frame and the existing building cladding indicated to support the glazed aluminum window wall work. Notify Contractor in writing, of any dimensions, or conditions, found which will prevent the proper execution of the glazed aluminum window wall work, including specified tolerances. Use Contractor's offset lines and bench marks as basis of measurements.

### 3.3 INSTALLATION

- A. General: Comply with manufacturer's written instructions for protecting, handling, and installing glazed aluminum window wall systems. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure non-movement joints. Loose particles present or resulting from fabrication or field cutting and drilling shall be removed by blowing out joints with oil free compressed air, or by vacuuming joints. Remove protective coatings, oils from cutting and drilling operations, and residue on metallic surfaces with solvents that leave no residue. Do not allow solvent to air dry without wiping. Use only lint free towels for wiping of surfaces. Wipe metal surfaces with IPA (isopropyl alcohol) or xylene unless otherwise required by compatibility and adhesion testing results. Seal joints watertight. Clean excess joint sealants from finished surfaces.
1. Cut and trim component parts of the glazed aluminum window wall work during erection only with the approval of the manufacturer or fabricator, and in accordance with his recommendations. Restore finish completely to protect material and remove all evidence of cutting and trimming. Remove and replace members where cutting and trimming has impaired strength or appearance, as directed by Architect.
  2. Set components within the erection tolerances with uniform joints. Place components on shims and fasten to supporting substrates using bolts and similar fasteners. Use stainless steel shims at structural connections only. U-shaped shims at structural connections are not permitted. Use aluminum, stainless steel, or high impact polystyrene shims at other connections.
  3. Do not erect components that are warped, deformed, bowed, dented, defaced or otherwise damaged as to impair its strength or appearance. Remove and replace members damaged in the process of erection.
  4. Coat concealed surfaces of dissimilar materials, and any ferrous metal components, with a heavy coating of bituminous paint, zinc rich primer or other separation in accordance with manufacturer's recommendations. Where aluminum components will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
  5. No holes or slots shall be burned, cut into, or field drilled in any building framing member without the written acceptance of the structural engineer.
- B. Glazed Aluminum Window Wall, Entrance and Storefront Framing: Install framing components plumb and true in alignment with established lines and grades without warp or rack of framing members.
- C. Entrance Doors: Doors shall be securely anchored in place to a straight, plumb and level condition, without distortion. Adjust doors to provide a tight fit at contact points for weathertight closure and to operate smoothly, without binding, with hardware functioning properly. Weatherstripping contact, and hardware movement, shall be field tested and final adjustment, and lubrication, made for proper operation and performance of doors.
1. Door Hardware: Refer to Section 08 71 00 "Door Hardware."

- D. Flashing: Install flashings fabricated from specified flashing material to the profiles shown. Flashings shall be furnished in single piece lengths. Laps and joints, where required, shall be lap seamed by a minimum of 4 inches with lap completely embedded in sealant. Mechanical fasteners shall be used where necessary to maintain contact of overlapping elements. Spot heads of all fasteners with sealant. Refer to Section 07 62 00 "Sheet Metal Flashing and Trim."
- E. Install glazing to comply with requirements of Section 08 80 00 "Glazing," unless otherwise indicated.
- F. Install perimeter sealant to comply with requirements of Section 07 92 00 "Joint Sealants," unless otherwise indicated.
- G. Concealed Sealing Components: Apply sealant and gasket components which are integral to the glazed aluminum window wall systems in strict accordance with the each component manufacturer's printed instructions. Before applying components remove all mortar, dust, dirt, moisture, and other foreign matter that will be deleterious to the intended performance of the component. Mask adjoining exposed surfaces to avoid spilling, dripping, dropping or other unintended contact of the sealing components onto adjacent exposed surfaces.
- H. Field Applied Insulation:
  - 1. Exterior Wall Building Insulation: Install insulation materials as specified in Section 07 21 00 "Thermal Insulation."

### 3.4 ERECTION TOLERANCES

- A. The glazed aluminum window wall systems shall be fabricated and erected to accommodate the dimensional tolerances of the structural frame and surrounding cladding while providing the following as installed tolerances.
  - 1. Variation from theoretical calculated position as located in plan or elevation in relation to established floors lines, column lines and other fixed elements of the structure, including variations from plumb, level, straight and member size: +/- 1/4 inch max in any 20'-0" run, column-to-column bay, or floor-to-floor height.
  - 2. Alignment: Where surfaces abut in line, and meet at corners, limit offset from true alignment to 1/32 inch.
  - 3. Variation from angle, or plumb, shown: +/- 1/8 inch max in any 10'-0"run or story height, non-cumulative.
  - 4. Variation from level shown: +/- 1/8 inch max in any 20'-0"run or column-to-column bay, non-cumulative.

### 3.5 ANCHORAGE

- A. Anchorage of the glazed aluminum window wall work to the structure and surrounding cladding shall be in accordance with the accepted shop drawings.



### **3.6 WELDING**

- A. Weld with electrodes and by methods recommended by manufacturer of material being welded, and in accordance with AWS D1.1 for concealed steel members.
- B. Welds and adjacent metal areas shall be thoroughly cleaned and coated with a single coat of bituminous paint.

### **3.7 REMOVAL OF DEBRIS**

- A. All debris caused by, or incidental to, the erection of the glazed aluminum window wall work shall be removed from the site and disposed of legally.

### **3.8 CLEANING**

- A. Clean metal surfaces promptly after installation, exercising care to avoid damage to factory finished exposed surfaces.
- B. Wash glass on both faces not more than 4 days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer. Remove excess glazing and sealant compounds, dirt, and other substances.
- C. Immediately remove any deleterious material from surfaces of aluminum.

### **3.9 PROTECTION**

- A. Institute protective measures required throughout the remainder of the construction period to ensure that glazed aluminum window wall work will be without damage or deterioration, other than normal weathering, at time of acceptance.

**END OF SECTION**

## SECTION 08 71 00 - DOOR HARDWARE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Door hardware, including electric hardware.
  2. Storefront and entrance door hardware.
  3. Gate Hardware.
  4. Impact system frame/door/hardware assembly.
  5. Card Access control system.
  6. Wall or floor-mounted electromagnetic hold-open devices.
  7. Power supplies for electric hardware.
  8. Remote button release hardware.
  9. Door position switches.
  10. Point-to-point wiring diagrams for electric hardware.
- B. Related Divisions:
1. Division 06 – door hardware installation
  2. Division 07 – sealant at exterior thresholds
  3. Division 08 – metal doors and frames, interior aluminum frames, wood doors, integrated security systems, specialty doors, storefront and glazed curtainwall systems.
  4. Division 10 – operable partitions
  5. Division 21 – fire and life safety systems
  6. Division 28 – security access systems
- C. Specific Omissions: Hardware for the following is specified or indicated elsewhere.
1. Windows.
  2. Cabinets, including open wall shelving and locks.
  3. Signs, except where scheduled.
  4. Toilet accessories, including grab bars.
  5. Installation.
  6. Rough hardware.
  7. Conduit, junction boxes & wiring.
  8. Folding partitions, except cylinders where detailed.
  9. Sliding aluminum doors, except cylinders where detailed.
  10. Access doors and panels, except cylinders where detailed.
  11. Corner Guards.
  12. Welded steel gates and supports.

#### 1.2 REFERENCES:

- A. Use date of standard in effect as of Bid date.
1. American National Standards Institute
    - a) ANSI 156.18 – Materials and Finishes.
  2. BHMA – Builders Hardware Manufacturers Association

3. 2019 California Building Code
    - a) Chapter 11B – Accessibility To Public Buildings, Public Accommodations, Commercial Buildings and Public Housing
  4. DHI – Door and Hardware Institute
  5. NFPA – National Fire Protection Association
    - a) NFPA 80 2016 Edition – Standard for Fire Doors and Other Opening Protectives.
    - b) NFPA 105 – Smoke and Draft Control Door Assemblies
    - c) NFPA 252 – Fire Tests of Door Assemblies
  6. UL – Underwriters Laboratories
    - a) UL10C – Positive Pressure Fire Tests of Door Assemblies.
    - b) UL 305 – Panic Hardware
  7. WHI – Warnock Hersey Incorporated State of California Building Code
  8. Local applicable codes
  9. SDI – Steel Door Institute
  10. WI – Woodwork Institute
  11. AWI – Architectural Woodwork Institute
  12. NAAMM – National Association of Architectural Metal Manufacturers
  13. ADA – 2010 Americans with Disabilities Act Accessibility Standards
- B. Abbreviations
1. Manufacturers: see table at 2.1.A of this section
  2. Finishes: see 2.7 of this section.

### 1.3 SUBMITTALS & SUBSTITUTIONS

- A. **SUBMITTALS:** Submit six copies of schedule per D. Only submittals printed one sided will be accepted and reviewed. Organize vertically formatted schedule into “Hardware Sets” with index of doors and headings, indicating complete designations of every item required for each door or opening. Minimum 10pt font size. Include following information:
1. Type, style, function, size, quantity and finish of hardware items.
  2. Use BHMA Finish codes per ANSI A156.18.
  3. Name, part number and manufacturer of each item.
  4. Fastenings and other pertinent information.
  5. Location of hardware set coordinated with floor plans and door schedule.
  6. Explanation of abbreviations, symbols, and codes contained in schedule.
  7. Mounting locations for hardware.
  8. Door and frame sizes, materials and degrees of swing.
  9. List of manufacturers used and their nearest representative with address and phone number.
  10. Catalog cuts.
  11. Point-to-point wiring diagrams.
  12. Manufacturer’s technical data and installation instructions for electronic hardware.
- B. Bid and submit manufacturer’s updated/improved item if scheduled item is discontinued.

- C. Deviations: Highlight, encircle or otherwise identify deviations from “Schedule of Finish Hardware” on submittal with notations clearly designating those portions as deviating from this section.
- D. If discrepancy between drawings and scheduled material in this section, bid the more expensive of the two choices, note the discrepancy in the submittal and request direction from Architect for resolution.
- E. Substitutions per Division 1. Include product data and indicate benefit to the Project. Furnish operating samples on request.
- F. Items listed with no substitute manufacturers have been requested by Owner to meet existing standard.
- G. Furnish as-built/as-installed schedule with closeout documents, including keying schedule, riser and point-to-point wiring diagrams, manufacturers’ installation, adjustment and maintenance information, and supplier’s final inspection report.

#### 1.4 QUALITY ASSURANCE:

- A. Qualifications:
  - 1. Hardware supplier: direct factory contract supplier who employs a certified architectural hardware consultant (AHC), available at reasonable times during course of work for project hardware consultation to Owner, Architect and Contractor.
    - a) Responsible for detailing, scheduling and ordering of finish hardware. Detailing implies that the submitted schedule of hardware is correct and complete for the intended function and performance of the openings.
- B. Hardware: Free of defects, blemishes and excessive play. Obtain each kind of hardware (latch and locksets, exit devices, hinges and closers) from one manufacturer.
- C. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.
- D. Fire-Rated Openings: NFPA 80 compliant. Hardware UL10C (positive pressure) compliant for given type/size opening and degree of label. Provide proper latching hardware, non-flaming door closers, approved-bearing hinges, and resilient seals. Coordinate with wood door section for required intumescent seals. Furnish openings complete.
- E. Furnish hardware items required to complete the work in accordance with specified performance level and design intent, complying with manufacturers’ instructions and code requirements.
- F. Pre-Installation Meetings: Initiate and conduct with supplier, installer and related trades, coordinate materials and techniques, and sequence complex hardware items and systems installation. Include manufacturers' representatives of locks, panic hardware and door closers in the meetings. Convene prior to commencement of related work.

#### 1.5 DELIVERY, STORAGE AND HANDLING:

- A. Delivery: coordinate delivery to appropriate locations (shop or field).

1. Permanent keys and cores: secured delivery direct to Owner's representative.
- B. Acceptance at Site: Items individually packaged in manufacturers' original containers, complete with proper fasteners and related pieces. Clearly mark packages to indicate contents, locations in hardware schedule and door numbers.
- C. Storage: Provide securely locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, dust, excessive heat and cold, etc.

#### 1.6 PROJECT CONDITIONS AND COORDINATION:

- A. Where exact types of hardware specified are not adaptable to finished shape or size of members requiring hardware, provide suitable types having as nearly as practical the same operation and quality as type specified, subject to Architect's approval.
- B. Coordination: Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents. Furnish related trades with the following information:
  1. Location of embedded and attached items to concrete.
  2. Location of wall-mounted hardware, including wall stops.
  3. Location of finish floor materials and floor-mounted hardware.
  4. At masonry construction, coordinate with the anchoring and hollow metal supplier prior to frame installation by placing a strip of insulation, wood, or foam, on the back of the hollow metal frame behind the rabbet section for continuous hinges, as well as at rim panic hardware strike locations, silencers, coordinators, and door closer arm locations. When the frame is grouted in place, the backing will allow drilling and tapping without dulling or breaking the installer's bits.
  5. Locations for conduit and raceways as needed for electrical, electronic and electro-pneumatic hardware items. Fire/life-safety system interfacing. Point-to-point wiring diagrams plus riser diagrams to related trades.
  6. Coordinate: low-voltage power supply locations.
  7. Coordinate: back-up power for doors with automatic operators.
  8. Coordinate: flush top rails of doors at outswinging exteriors, and throughout where adhesive-mounted seals occur.
  9. Manufacturers' templates to door and frame fabricators.
- C. Check Shop Drawings for doors and entrances to confirm that adequate provisions will be made for proper hardware installation.
- D. Environmental considerations: segregate unused recyclable paper and paper product packaging, uninstalled metals, and plastics, and have these sent to a recycling center.

#### 1.7 WARRANTY:

- A. Part of respective manufacturers' regular terms of sale. Provide manufacturers' written warranties.
- B. Include factory order numbers with close-out documents to validate warranty information, required for Owner in making future warranty claims:

**C. Minimum warranties:**

- |                   |   |
|-------------------|---|
| 1. Locksets:      | Three years                                   |
| 2. Exit Devices:  | Three years mechanical<br>One year electrical |
| 3. Closers:       | Thirty years mechanical                       |
| 4. Hinges:        | One year                                      |
| 5. Other Hardware | Two years                                     |

**1.8 COMMISSIONING:**

- A. Conduct these tests prior to request for certificate of substantial completion:
1. With installer present, test door hardware operation with climate control system and stairwell pressurization system both at rest and while in full operation.
  2. With installer, access control contractor and electrical contractor present, test electrical, electronic and electro-pneumatic hardware systems for satisfactory operation.
  3. With installer and electrical contractor present, test hardware interfaced with fire/life-safety system for proper operation and release.

**1.9 REGULATORY REQUIREMENTS:**

- A. Locate latching hardware between 34 inches to 44 inches above the finished floor, per 2019 California Building Code, Section 11B-404.2.7.
1. Panic hardware: locate between 36 inches to 44 inches above the finished floor.
- B. Handles, pull, latches, locks, other operable parts:
1. Readily openable from egress side with one hand and without tight grasping, tight pinching, or twisting of the wrist to operate. 2019 California Building Code Section 11B-309.4.
  2. Force required to activate the operable parts: 5.0 pounds maximum, per 2019 California Building Code Section 11B-309.4.
- C. Adjust doors to open with not more than 5.0-pounds pressure to open at exterior doors and 5.0-pounds at interior doors. As allowed per 2019 California Building Code Section 11B-404.2.9, local authority may increase the allowable pressure for fire doors to achieve positive latching, but not to exceed 15-pounds.
1. Exception: exterior doors' pressure-to-open may be increased to 8.5-pounds if: at a single location, and one of a bank of eight leafs or fraction of eight, and one leaf of this bank is fitted with a low- or high-energy operator.
- D. Low-energy powered doors: comply with ANSI/BHMA A156.19. Reference: 2019 California Building Code Section 11B-404.2.9.
1. Where powered door serves an occupancy of 100 or more, provide back-up battery power or stand-by generator power, capable of supporting a minimum of 100 cycles.

2. Actuators, vertical bar type: minimum 2-inches wide, 30-inches high, bottom located minimum 5-inches above floor or ground, top located minimum 35-inches above floor or ground. Displays International Symbol of Accessibility, per 2019 California Building Code Section 11B-703.7.
  3. Actuators, plate type: use two at each side of the opening. Minimum 4-inches diameter or 4-inches square. Displays International Symbol of Accessibility, per 2019 California Building Code Section 11B-703.7. Locate centerline of lower plate between 7- and 8-inches above floor or ground, and upper plate between 30- and 44-inches above floor or ground.
  4. Actuator location: conspicuously located, clear and level floor/ground space for forward or parallel approach.
- E. Adjust door closer sweep periods so that from an open position of 90 degrees, the door will take at least 5 seconds to move to a point 12 degrees from the latch, measured to the landing side of the door, per 2019 California Building Code Section 11B-404.2.8.
1. Spring hinges: adjust for 1.5 seconds minimum for 70 degrees to fully-closed.
- F. Smooth surfaces at bottom 10 inches of push sides of doors, facilitating push-open with wheelchair footrests, per 2019 California Building Code Section 11B-404.2.10.
1. Applied kickplates and armor plates: bevel the left and right edges; free of sharp or abrasive edges.
  2. Tempered glass doors without stiles: bottom rail may be less than 10 inches if top leading edge is tapered 60 degrees minimum.
- G. Door opening clear width no less than 32 inches, measured from face of frame stop, or edge of inactive leaf of pair of doors, to door face with door opened to 90 degrees. Hardware projection not a factor in clear width if located above 34 inches and below 80 inches, and the hardware projects no more than 4 inches. 2019 California Building Code Section 11B-404.2.3.
1. Exception: doors not requiring full passage through the opening, that is, to spaces less than 24 inches in depth, may have the clear opening width reduced to 20 inches. Example: shallow closets.
  2. Door closers and overhead stops: not less than 78 inches above the finished floor or ground, per 2019 California Building Code 11B-307.4.
- H. Thresholds: floor or landing no more than 0.50 inches below the top of the threshold of the doorway, per 2019 California Building Code Section 11B-404.2.5. Vertical rise no more than 0.25 inches, change in level between 0.25 inches and 0.50 inches: beveled to slope no greater than 1:2 (50 percent slope). 2019 California Building Code Section 11B-303.2 & ~.3.
- I. Floor stops: Do not locate in path of travel. Locate no more than 4 inches from walls, per DSA Policy #99-08 (Access).
- J. Pairs of doors with independently-activated hardware both leafs: limit swing of right-hand or right-hand-reverse leaf to 90 degrees to protect persons reading wall-mounted tactile signage, per 2019 California Building Code Section 11B-703.4.2.

- K. Door and door hardware encroachment: when door is swung fully-open into means-of-egress path, the door may not encroach/project more than 7 inches into the required exit width, with the exception of door release hardware such as lockset levers or panic hardware. These hardware items must be located no less than 34-inches and no more than 48-inches above the floor/ground. 2019 California Building Code, Section 1005.7.1.
  - 1. In I-2 occupancies, surface mounted latch release hardware, mounted to the side of the door facing away from the adjacent wall where the door is in the open position, is not exempt from the inclusion in the 7-inch maximum encroachment, regardless of its mounting height, per 2019 California Building Code, Section 1005.7.1 at Exception 1.



## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS:

- A. Listed acceptable alternate manufacturers: these will be considered; submit for review products with equivalent function and features of scheduled products.

ITEM:	MANUFACTURER:	ACCEPTABLE ALTERNATE:
Hinges	(IVE) Ives	Bommer
Continuous Hinges	(IVE) Ives	Select
Key System	(MED) MEDECO	Owner standard
Mechanical Locks	(SCH) Schlage	Owner standard
Electronic Locks	(SCE) Schlage Electronics	Owner standard
Exit Devices	(VON) Von Duprin	Owner standard
Closers	(LCN) LCN	Owner standard
Auto Flush Bolts	(IVE) Ives	DCI
Coordinators	(IVE) Ives	DCI
Silencers	(IVE) Ives	Rockwood, Trimco
Push & Pull Plates	(IVE) Ives	Rockwood, Trimco
Kickplates	(IVE) Ives	Rockwood, Trimco
Stops & Holders	(IVE) Ives	Rockwood, Trimco
Overhead Stops	(GLY) Glynn-Johnson	ABH
Thresholds	(ZER) Zero	NGP, Pemko
Seals & Bottoms	(ZER) Zero	NGP, Pemko

### 2.2 HINGING METHODS:

- A. Drawings typically depict doors at 90 degrees, doors will actually swing to maximum allowable. Use wide-throw conventional or continuous hinges as needed up to 8 inches in width to allow door to stand parallel to wall for true 180-degree opening. Advise architect if 8-inch width is insufficient.

- B. Conform to manufacturer's published hinge selection standard for door dimensions, weight and frequency, and to hinge selection as scheduled. Where manufacturer's standard exceeds the scheduled product, furnish the heavier of the two choices, notify Architect of deviation from scheduled hardware.
- C. Conventional Hinges: Steel or stainless-steel pins and approved bearings. Hinge open widths minimum, but of sufficient throw to permit maximum door swing.
  - 1. Outswinging exterior doors: non-ferrous with non-removable (NRP) pins and security studs.
  - 2. Non-ferrous material exteriors and at doors subject to corrosive atmospheric conditions.
- D. Continuous Hinges:
  - 1. Geared-type aluminum.
    - a) Use wide-throw units where needed for maximum degree of swing, advise architect if commonly available hinges are insufficient.
    - b) If units are used at storefront openings, color-coordinate hinge finish with storefront color. Custom anodizing and custom powdercoat finishes subject to Architect approval.
  - 2. Pinned steel/stainless steel type: continuous stainless steel, 0.25-inch diameter stainless-steel hinge pin.
    - a) Use engineered application-specific wide-throw units as needed to provide maximum swing degree of swing, advise architect if required width exceeds 8 inches.

### 2.3 LOCKSETS, LATCHSETS, DEADBOLTS:

- A. Mortise Locksets and Latchsets: as scheduled.
  - 1. Chassis: cold-rolled steel, handing field-changeable without disassembly.
  - 2. Universal lock case – 10 functions in one case.
  - 3. Floating mounting tabs automatically adjusts to fit a beveled door edge.
  - 4. Latchbolts: 0.75 inch throw stainless steel anti-friction type.
  - 5. Lever Trim: through-bolted, accessible design, cast lever or solid extruded bar type levers as scheduled. Filled hollow tube design unacceptable.
    - a) Spindles: security design independent breakaway. Breakage of outside lever does not allow access to inside lever's hubworks to gain wrongful entry.
    - b) Inside lever applied by screwless shank mounting – no exposed trim mount screws.
    - c) Levers rotate up or down for ease of use.
    - d) Vandalgard locks: locked lever freely rotates down while remaining securely locked. This feature prevents damage to internal lock components when subjected to excessive force.
  - 6. Furnish solid cylinder collars with wave springs. Wall of collar to cover rim of mortise cylinder.
  - 7. Turnpieces: accessible offset turn-lever design not requiring pinching or twisting motions to operate.

8. Deadbolts: stainless steel 1-inch throw.
9. Electric operation: Manufacturer-installed continuous duty solenoid.
10. Strikes: 16 gage curved steel, bronze or brass with 1 inch deep box construction, lips of sufficient length to clear trim and protect clothing.
11. Scheduled Lock Series and Design: Schlage L series, 06A design.
12. Certifications:
  - a) ANSI A156.13, Grade 1 Operational, Grade 1 Security.
  - b) ANSI/ASTM F476-84 Grade 31 UL Listed.
13. Accessibility: Require not more than 5 lb to retract the latchbolt or deadbolt, or both, per CBC 2019 11B-404.2.7 and 11B-309.4.

## 2.4 EXIT DEVICES / PANIC HARDWARE

### A. General features:

1. Independent lab-tested 1,000,000 cycles.
2. Push-through push-pad design. No exposed push-pad fasteners, no exposed cavities when operated. Return stroke fluid dampeners and rubber bottoming dampeners, plus anti-rattle devices.
3. Deadlocking latchbolts, 0.75 inch projection.
4. End caps: impact-resistant, flush-mounted. No raised edges or lips to catch carts or other equipment.
5. No exposed screws to show through glass doors.
6. Non-handed basic device design with center case interchangeable with all functions, no extra parts required to effect change of function.
7. Releasable in normal operation with 15-pound maximum operating force per UBC Standard 10-4, As allowed per 2019 California Building Code Section 11B-404.2.9, local authority may increase the allowable pressure for fire doors to achieve positive latching, but not to exceed 15-pounds and with 32-pound maximum pressure under 250-pound load to the door.
8. Exterior doors scheduled with XP-series devices: Static load force resistance of at least 2000 pounds.
9. Accessibility: Require not more than 5 lb to retract the latchbolt, per CBC 2019 11B-404.2.7 and 11B-309.4.
  - a) Mechanical method: Von Duprin "AX-" feature, where touchpad directly retracts the latchbolt with 5 lb or less of force. Provide testing lab certification confirming that the mechanical device is independent third-party tested to meet this 5 lb requirement.
  - b) Electrical method: Von Duprin's "RX-QEL-", where lightly pressing the touchpad with 5 lb or less of force closes an electric switch, activating quiet electric latch retraction.

### B. Specific features:

1. Non-Fire Rated Devices: cylinder dogging with indication.
2. Lever Trim: breakaway type, forged brass or bronze escutcheon min. 0.130 inch thickness, compression spring drive, match lockset lever design.
3. Fire-Labeled Devices: UL label indicating "Fire Exit Hardware". Vertical rod devices less bottom rod (LBR) unless otherwise scheduled.

4. Impact recessed devices: 1.25 inch projection when push-pad is depressed. Sloped metal end caps to deflect carts, etc. No pinch points to catch skin between touchbar and door.
5. Electrically Operated Devices: Single manufacturer source for electric latch retraction devices, electrically controlled trim, power transfers, power supplies, monitoring switches and controls.
6. Removable Mullions: Removable with single turn of building key. Securely reinstalled without need for key. Furnish storage brackets for securely stowing the mullion away from the door when removed.
7. Accepted substitutions: None, Campus Standard.

## 2.5 CLOSERS

### A. Surface Closers:

1. Full rack-and-pinion type cylinder with removable non-ferrous cover and cast iron body. Double heat-treated pinion shaft, single piece forged piston, chrome-silicon steel spring.
2. ISO 2000 certified. Units stamped with date-of-manufacture code.
3. Independent lab-tested 10,000,000 cycles.
4. Non-sized, non-handed, and adjustable. Place closer inside building, stairs, and rooms.
5. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.
6. Adjust doors to open with not more than 5.0-pounds pressure to open at exterior doors and 5.0-pounds at interior doors. As allowed per 2019 California Building Code Section 11B-404.2.9, local authority may increase the allowable pressure for fire doors to achieve positive latching, but not to exceed 15-pounds.
  - a) Exception: exterior doors' pressure-to-open may be increased to 8.5-pounds if: at a single location, and one of a bank of eight leafs or fraction of eight, and one leaf of this bank is fitted with a low- or high-energy operator.
7. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
8. Extra-duty arms (EDA) at exterior doors scheduled with parallel arm units.
9. Exterior door closers: tested to 100 hours of ASTM B117 salt spray test, furnish data on request.
10. Exterior doors: seasonal adjustments not required for temperatures from 120 degrees F to -30 degrees F, furnish checking fluid data on request.
11. Non-flaming fluid, will not fuel door or floor covering fires.
12. Pressure Relief Valves (PRV) not permitted.
13. Accepted substitutions: None, Campus Standard.

## 2.6 OTHER HARDWARE

- ### A. Automatic Flush Bolts: Low operating force design.

- B. Overhead Stops: Non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.
- C. Kick Plates: Four beveled edges, .050 inches minimum thickness, height and width as scheduled. Sheet-metal screws of bronze or stainless steel to match other hardware.
- D. Door Stops: Provide stops to protect walls, casework or other hardware.
  - 1. Unless otherwise noted in Hardware Sets, provide floor type with appropriate fasteners. Where floor type cannot be used, provide wall type. If neither can be used, provide overhead type.
  - 2. Locate overhead stops for maximum possible opening. Consult with Owner for furniture locations. Minimum: 90deg stop / 95deg deadstop. Note degree of opening in submittal.
- E. Automatic door bottoms: low operating force units. Doors with automatic door bottoms plus head and jamb seals cannot require more than two pounds operating force to open when closer is disconnected.
  - 1. Include automatic type door bottoms, as opposed to fixed sweeps, at stairs and elevator lobbies to allow fine-tuning of pressurization systems.
- F. Thresholds: As scheduled and per details. Comply with CBC 2019 11B-404.2.5. Substitute products: certify that the products equal or exceed specified material's thickness. Proposed substitutions: submit for approval.
  - 2. Saddle thresholds: 0.125 inches minimum thickness.
  - 3. Exteriors: Seal perimeter to exclude water and vermin. Use sealant complying with requirements in Division 7 "Thermal and Moisture Protection". Minimum 0.25 inch diameter fasteners and lead expansion shield anchors, or Red-Head #SFS-1420 (or approved equivalent) Flat Head Sleeve Anchors. National Guard Products' "COMBO" or Pemko Manufacturing's "FHSL".
  - 4. Fire-rated openings, 90-minutes or less duration: use thresholds to interrupt floor covering material under the door where that material has a critical radiant flux value less than 0.22 watts per square centimeter, per NFPA 253. Use threshold unit as scheduled. If none scheduled, include a 0.25in high 5in wide saddle in the bid, and request direction from Architect.
  - 5. Fire-rated openings, 3-hour duration: Thresholds, where scheduled, to extend full jamb depth.
  - 6. Acoustic openings: Set units in full bed of Division-7-compliant, leave no air space between threshold and substrate.
  - 7. Plastic plugs with wood or sheet metal screws are not an acceptable substitute for specified fastening methods.
  - 8. Fasteners: Generally, exposed screws to be Phillips or Robertson drive. Pinned TORX drive at high security areas. Flat head sleeve anchors (FHSL) may be slotted drive. Sheet metal and wood screws: full-thread. Sleeve nuts: full length to prevent door compression.
- G. Through-bolts: Do not use. Coordinate with wood doors; ensure provision of proper blocking to support wood screws for mounting panic hardware and door closers. Coordinate with metal doors and frames; ensure provision of proper reinforcement to support machine screws for mounting panic hardware and door closers.
  - 1. Exception: surface-mounted overhead stops, holders, and friction stays.

- H. Silencers: Interior hollow metal frames, 3 for single doors, 4 for pairs of doors. Leave no unfilled/uncovered pre-punched silencer holes. Intent: door bears against silencers, seals make minimal contact with minimal compression – only enough to effect a seal.
- I. Wall- & Floor-mounted electromagnetic door holders: LCN's SEM series or approved equivalent. Incorporate into U.L. listed fire & life-safety system, doors release to allow closure and latching when door's zone is in alarm state. Use minimum projection required to allow door to open as widely as allowed by wall conditions and projection of door hardware.

## 2.7 FINISH:

- A. Generally: BHMA 626 Satin Chromium.
  - 1. Areas using BHMA 626: furnish push-plates, pulls and protection plates of BHMA 630, Satin Stainless Steel, unless otherwise scheduled.
- B. Door closers: factory powder coated to match other hardware, unless otherwise noted.

## 2.8 KEYING REQUIREMENTS:

- A. Key System: Verify with Owner. Existing Medeco system. Initiate and conduct meeting(s) with Owner to determine system structure, furnish Owner's written approval of the system; do not order keys or cylinders without written confirmation of actual requirements from the Owner. Furnish temporary construction-keyed and permanent cylinders. Contractor to demonstrate to the Owner that temporary keys no longer operate the locking cylinders at the end of the project.

## PART 3 - EXECUTION

### 3.1 ACCEPTABLE INSTALLERS:

- A. Can read and understand manufacturers' templates, suppliers' hardware schedule and printed installation instructions. Can readily distinguish drywall screws from manufacturers' furnished fasteners. Available to meet with manufacturers' representatives and related trades to discuss installation of hardware.

### 3.2 PREPARATION:

- A. Ensure that walls and frames are square and plumb before hardware installation. Make corrections before commencing hardware installation. Installation denotes acceptance of wall/frame condition.
- B. Locate hardware per SDI-100 and applicable building, fire, life-safety, accessibility, and security codes.
  - 1. Notify Architect of code conflicts before ordering material.
  - 2. Locate latching hardware between 34 inches to 44 inches above the finished floor, per California Building Code, Section 1010.1.9.2 and 11B-404.2.7.
  - 3. Locate panic hardware between 36 inches to 44 inches above the finished floor.
  - 4. Where new hardware is to be installed near existing doors/hardware scheduled to remain, match locations of existing hardware.

- C. Overhead stops: before installing, determine proposed locations of furniture items, fixtures, and other items to be protected by the overhead stop's action.

### 3.3 INSTALLATION

- A. Install hardware per manufacturer's instructions and recommendations. Do not install surface-mounted items until finishes have been completed on substrate. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate for proper installation and operation. Remove and reinstall or replace work deemed defective by Architect.
  - 1. Gaskets: install jamb-applied gaskets before closers, overhead stops, rim strikes, etc; fasten hardware over and through these seals. Install sweeps across bottoms of doors before astragals, cope sweeps around bottom pivots, trim astragals to tops of sweeps.
  - 2. When hardware is to be attached to existing metal surface and insufficient reinforcement exists, use RivNuts, NutSerts or similar anchoring device for screws.
  - 3. Use manufacturers' fasteners furnished with hardware items, or submit Request for Substitution with Architect.
  - 4. Replace fasteners damaged by power-driven tools.
- B. Locate floor stops no more that 4 inches from walls and not within paths of travel. See paragraph 2.2 regarding hinge widths, door should be well clear of point of wall reveal. Point of door contact no closer to the hinge edge than half the door width. Where situation is questionable or difficult, contact Architect for direction.
- C. Core concrete for exterior door stop anchors. Set anchors in approved non-shrink grout.
- D. Locate overhead stops for minimum 90 degrees at rest and for maximum allowable degree of swing.
- E. Drill pilot holes for fasteners in wood doors and/or frames.
- F. Lubricate and adjust existing hardware scheduled to remain. Carefully remove and give to Owner items not scheduled for reuse.

### 3.4. ADJUSTING

- A. Adjust and check for proper operation and function. Replace units, which cannot be adjusted to operate freely and smoothly.
  - 1. Hardware damaged by improper installation or adjustment methods: repair or replace to Owner's satisfaction.
  - 2. Adjust doors to fully latch with no more than 1 pound of pressure.
    - a) Door closer valves: turn valves clockwise until at bottom – do not force. Turn valves back out one and one-half turns and begin adjustment process from that point. Do not force valves beyond three full turns counterclockwise.
  - 3. Adjust delayed-action closers on fire-rated doors to fully close from fully-opened position in no more than 10 seconds.
  - 4. Adjust door closers per 1.9 this section.

- B. Inspection of fire door assemblies and means-of-egress panic-hardware doors: Per 2016 NFPA-80 5.2.1: hire an independent third-party inspection service to prepare a report listing these doors, and include a statement that there are zero deficiencies with the fire-rated assemblies and the openings with panic hardware.
- C. Fire-rated doors:
  - 1. Wood doors: adjust to 0.125 inches clearance at heads, jambs, and meeting stiles.
  - 2. Steel doors: adjust to 0.063 inches minimum to 0.188 inches maximum clearance at heads, jambs, and meeting stiles.
  - 3. Adjust wood and steel doors to 0.75 inches maximum clearance (undercut) above threshold or finish floor material under door.
- D. Final inspection: Installer to provide letter to Owner that upon completion installer has visited the Project and has accomplished the following:
  - 1. Has re-adjusted hardware.
  - 2. Has evaluated maintenance procedures and recommend changes or additions, and instructed Owner's personnel.
  - 3. Has identified items that have deteriorated or failed.
  - 4. Has submitted written report identifying problems.

### **3.5 DEMONSTRATION:**

- A. Demonstrate mechanical hardware and electrical, electronic and pneumatic hardware systems, including adjustment and maintenance procedures.

### **3.6 PROTECTION/CLEANING:**

- A. Cover installed hardware, protect from paint, cleaning agents, weathering, carts/barrows, etc. Remove covering materials and clean hardware just prior to substantial completion.
- B. Clean adjacent wall, frame and door surfaces soiled from installation / reinstallation process.

### **3.7 SCHEDULE OF FINISH HARDWARE**

- A. Hardware Schedule is bound in immediately following this Section. See door schedule in drawings for hardware set assignments.
- B. Do not order material until submittal has been reviewed, stamped, and signed by Architect's door hardware consultant.
- C. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

**END OF SECTION 08 71 00**

















HEADING 01

1	SGL	Door 121A	EXTERIOR / ANTHROPOLOGY
1	SGL	Door 122A	EXTERIOR / ARCHITECTURE 1
1	SGL	Door 123A	EXTERIOR / ARCHITECTURE 2

36.000 X 84.000 X 1.750 X A/G X ALF X --

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	PA MOUNTING PLATE	4040XP-18PA (AS REQUIRED)	 689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 (AS REQUIRED)	 689	LCN
1	EA	CONT. HINGE	224XY EPT	 628	IVE
1	EA	POWER TRANSFER	EPT10 CON	 689	VON
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-98-NL-OP-110MD- CON	 626	VON
1	EA	INTERFACE BOX	JB7		VON
1	EA	RIM CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA	DOOR PULL	VR910 NL	 630	IVE
1	EA	SURFACE CLOSER	4040XP HEDA	 689	LCN
1	EA	FLOOR STOP	FS18S	 BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	 AA	ZER
1	EA	DOOR SWEEP	39A	 A	ZER
1	EA	THRESHOLD	102A-223	 A	ZER
3	EA	WIRE HARNESS	CON-(LENGTH AS REQUIRED)		SCH
1	EA	MULTITECH READER	MTB15 5VDC - 28VDC	 BLK	SCE
1	EA	DOOR CONTACT	7764	 628	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 900-BBK 120/240 VAC		VON
1	EA	WIRING DIAGRAM	PROVIDE FACTORY POINT-TO- POINT WIRING DIAGRAM		VON

LOCK DOWN BUTTON SS2242LD-EN BY SECURITY CONTRACTOR  
CARD READER AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.  
DOOR CONTACT AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.

HEADING 02

1 SGL Door 121B EXTERIOR / ANTHROPOLOGY  
1 SGL Door 122B EXTERIOR / ARCHITECTURE 1  
36.000 X 84.000 X 1.750 X A/G X ALF X --

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	PA MOUNTING PLATE	4040XP-18PA (AS REQUIRED)	689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 (AS REQUIRED)	689	LCN
1	EA	CONT. HINGE	224XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-98-NL-OP-110MD-CON	626	VON
1	EA	INTERFACE BOX	JB7		VON
1	EA	RIM CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA	DOOR PULL	VR910 NL	630	IVE
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	102A-223	A	ZER
3	EA	WIRE HARNESS	CON-(LENGTH AS REQUIRED)		SCH
1	EA	MULTITECH READER	MTB15 5VDC - 28VDC	BLK	SCE
1	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 900-BBK 120/240 VAC		VON
1	EA	WIRING DIAGRAM	PROVIDE FACTORY POINT-TO-POINT WIRING DIAGRAM		VON

CARD READER AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.  
DOOR CONTACT AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.

HEADING 03

1 PR Door 129A EXTERIOR / ARCHITECTURE 4  
72.000 X 84.000 X 1.750 X A/G X ALF X --

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	MOUNTING PLATE	4040XP-18 (AS REQUIRED)	689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30 (AS REQUIRED)	689	LCN
2	EA	BLADE STOP SPACER	4040XP-61 (AS REQUIRED)	689	LCN
2	EA	CONT. HINGE	224XY EPT	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	REMOVABLE MULLION	KR4954	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-98-EO-CON	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-98-NL-OP-110MD-CON	626	VON
1	EA	INTERFACE BOX	JB7		VON
1	EA	RIM CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA	MORTISE CYLINDER	M3 CYLINDER AS REQUIRED (MULLION)	626	MED
1	EA	DOOR PULL	VR910 DT	630	IVE
1	EA	DOOR PULL	VR910 NL	630	IVE
2	EA	SURFACE CLOSER	4040XP SHCUSH	689	LCN
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	102A-223	A	ZER
6	EA	WIRE HARNESS	CON-(LENGTH AS REQUIRED)		SCH
1	EA	MULTITECH READER	MTB15 5VDC - 28VDC	BLK	SCE
2	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 900-BBK 120/240 VAC		VON
1	EA	WIRING DIAGRAM	PROVIDE FACTORY POINT-TO-POINT WIRING DIAGRAM		VON

LOCK DOWN BUTTON BY SECURITY CONTRACTOR SS2242LD-EN  
CARD READER AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.  
DOOR CONTACT AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.

HEADING 04

1 SGL Door 102A EXTERIOR / CLASSROOM  
1 SGL Door 103A EXTERIOR / CLASSROOM

36.000 X 84.000 X 1.750 X A/G X ALF X --

Each Assembly to have:

Qty		Description	Catalog Number		Finish	Mfr
1	EA	PA MOUNTING PLATE	4040XP-18PA (AS REQUIRED)		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 (AS REQUIRED)		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 (AS REQUIRED)		689	LCN
1	EA	CONT. HINGE	224XY		628	IVE
1	EA	PANIC HARDWARE	CDSI-PA-AX-98-NL-OP-110MD		626	VON
1	EA	MORTISE CYL TURN	09-900 114 XB11-720		626	SCH
1	EA	RIM CYLINDER	M3 CYLINDER AS REQUIRED		626	MED
1	EA	DOOR PULL	VR910 NL		630	IVE
1	EA	SURFACE CLOSER	4040XP SHCUSH		689	LCN
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	102A-223		A	ZER

DOOR SEALS PROVIDED BY ALUMINUM FRAME MANUFACTURER.

HEADING 05

1 SGL Door 126A EXTERIOR / WELLNESS

36.000 X 84.000 X 1.750 X HMD X HMF X --

Each Assembly to have:

Qty		Description	Catalog Number		Finish	Mfr
3	EA	HINGE	3CB1 SH 4.5 X 4.5 NRP		630	IVE
1	EA	PRIVACY W/DB & IND	L9496L 06A L583-363 XL11-986		626	SCH
1	EA	MORTISE CYLINDER	M3 CYLINDER AS REQUIRED		626	MED
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	PROTECTION PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS18S		BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)		AA	ZER
1	SET	SET SEAL	429AA-S (@ HEAD & JAMBS)		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	102A-223		A	ZER
1	EA	DOOR CONTACT	7764		628	SCE

HEADING 06

1 PR Door 131A EXTERIOR / ELECTRICAL  
72.000 X 84.000 X 1.750 X HMD X HMF X --

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
6	EA	HINGE	3CB1 SH 4.5 X 4.5 NRP	630	IVE
1	SET	CONST LATCHING BOLT	FB51P	630	IVE
1	EA	DUST PROOF STRIKE	DP1/2 AS REQ'D	626	IVE
1	EA	STOREROOM LOCK	L9080L LLL 06A L283-150	626	SCH
1	EA	MORTISE CYLINDER	M-3 PERMANENT CYLINDER	626	MED
1	EA	DOOR PULL	VR900 LLP	630	IVE
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	EA	SET SEAL	429AA-S (@ JAMBS)	AA	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	ASTRAGAL	44ST X 488SBK PSA	STST	ZER
1	EA	THRESHOLD	102A-223	A	ZER

HEADING 07

1 SGL Door 105A EXTERIOR / ADMIN  
1 SGL Door 105B EXTERIOR / CIRC  
36.000 X 84.000 X 1.750 X A/G X ALF X --

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	224XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-98-NL-OP-110MD-CON	626	VON
1	EA	INTERFACE BOX	JB7		VON
1	EA	RIM CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA	DOOR PULL	VR910 NL	630	IVE
1	EA	AUTOMATIC OPERATOR	SW200I X MTG PLATES AS REQ	AL	BSM
2	EA	ACTUATOR	I36-3	630	WIK
1	SET	BOLLARD ACTUATOR	B-6SQ-RT-DB-SM-INGR		WIK
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	102A-223	A	ZER
1	EA	BATTERY BACKUP	AS REQ BY SECURITY CONTRACTOR		SEC
3	EA	WIRE HARNESS	CON-(LENGTH AS REQUIRED)		SCH
1	EA	MULTITECH READER	MTB15 5VDC - 28VDC	BLK	SCE
1	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 900-BBK 120/240 VAC		VON
1	EA	WIRING DIAGRAM	PROVIDE FACTORY POINT-TO-POINT WIRING DIAGRAM		VON

LCOK DOWN BUTTON BY SECURITY CONTRACTOR SS2242LD-EN  
CARD READER AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.  
DOOR CONTACT AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.  
VERIFY WITH ARCHITECT FOR ACTUATOR LOCATIONS AND WALL MOUNTED OR IF BOLLARD IS REQUIRED.

HEADING 08

1 PR Door 128A EXTERIOR / STORAGE  
72.000 X 84.000 X 1.750 X HMD X HMF X --

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
6	EA	HINGE	3CB1 SH 4.5 X 4.5 NRP	630	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	SET	AUTO FLUSH BOLT	FB31P	630	IVE
1	EA	DUST PROOF STRIKE	DP1/2 AS REQ'D	626	IVE
1	EA	EU MORTISE LOCK	L9092LEU 06A RX CON 12/24 VDC	626	SCH
1	EA	INTERFACE BOX	JB7		VON
1	EA	MORTISE CYLINDER	M-3 PERMANENT CYLINDER	626	MED
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	SET SEAL	429AA-S (@ HEAD & JAMBS)	AA	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	102A-223	A	ZER
1	EA	BATTERY BACKUP	AS REQ BY SECURITY CONTRACTOR		SEC
3	EA	WIRE HARNESS	CON-(LENGTH AS REQUIRED)		SCH
1	EA	MULTITECH READER	MTB15 5VDC - 28VDC	BLK	SCE
1	EA	DOOR CONTACT	7764	628	SCE
1	EA	WIRING DIAGRAM	PROVIDE FACTORY POINT-TO-POINT WIRING DIAGRAM		VON

LOCK DOWN BUTTON BY SECURITY CONTRACTOR SS2242LD-EN  
CARD READER AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.  
DOOR CONTACT AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.

HEADING 09

1 SGL Door 111A CIRC / OFFICE  
1 SGL Door 112A CIRC / OFFICE  
1 SGL Door 113A CIRC / OFFICE  
1 SGL Door 114A CIRC / OFFICE

36.000 X 84.000 X 1.750 X A/G X ALF X --

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	224XY	628	IVE
1	EA	OFFICE W/IND.	L9050L 06A L583-363 L283-711	626	SCH
1	EA	MORTISE CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA	WALL STOP	WS401/402CCV	626	IVE

DOOR SEALS PROVIDED BY ALUMINUM FRAME MANUFACTURER.

HEADING 10

1 SGL Door 115A ADMIN / OFFICE  
1 SGL Door 116A ADMIN / OFFICE

36.000 X 84.000 X 1.750 X A/G X ALF X --

Each Assembly to have:

Qty	Description	Catalog Number	Finish	Mfr
1	EA CONT. HINGE	224XY	628	IVE
1	EA OFFICE W/IND.	L9050L 06A L583-363 L283-711	626	SCH
1	EA MORTISE CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA WALL STOP	WS401/402CCV	626	IVE
1	EA AUTO DOOR BOTTOM	369AA	AA	ZER

DOOR SEALS PROVIDED BY ALUMINUM FRAME MANUFACTURER.

HEADING 11

1 SGL Door 117A EXTERIOR / FIRE RISER

36.000 X 84.000 X 1.750 X HMD X HMF X --

Each Assembly to have:

Qty	Description	Catalog Number	Finish	Mfr
3	EA HINGE	3CB1 SH 4.5 X 4.5 NRP	630	IVE
1	EA STOREROOM LOCK	L9080L LLL 06A L283-150	626	SCH
1	EA MORTISE CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA DOOR PULL	VR900	630	IVE
1	EA SURFACE CLOSER	4040XP EDA	689	LCN
1	EA FLOOR STOP	FS18S	BLK	IVE
1	EA RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET SET SEAL	429AA-S (@ HEAD & JAMBS)	AA	ZER
1	EA DOOR SWEEP	39A	A	ZER
1	EA THRESHOLD	102A-223	A	ZER



HEADING 12

Each Assembly to have:

Qty		Description	Catalog Number		Finish	Mfr
1	EA	PA MOUNTING PLATE	4040XP-18PA (AS REQUIRED)		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 (AS REQUIRED)		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 (AS REQUIRED)		689	LCN
1	EA	CONT. HINGE	224XY		628	IVE
1	EA	PANIC HARDWARE	CDSI-PA-AX-98-NL-OP-110MD		626	VON
1	EA	MORTISE CYL TURN	09-900 114 XB11-720		626	SCH
1	EA	RIM CYLINDER	M3 CYLINDER AS REQUIRED		626	MED
1	EA	90 DEG OFFSET PULL	8190EZHD 10" O		630-316	IVE
1	EA	SURFACE CLOSER	4040XP SHCUSH		689	LCN
1	EA	DOOR CONTACT	7764		628	SCE

DOOR SEALS PROVIDED BY ALUMINUM FRAME MANUFACTURER.  
DOOR CONTACT AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.

HEADING 13

Each Assembly to have:

Qty		Description	Catalog Number		Finish	Mfr
1	EA	PA MOUNTING PLATE	4040XP-18PA (AS REQUIRED)		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 (AS REQUIRED)		689	LCN
1	EA	CONT. HINGE	224XY EPT		628	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-98-NL-OP-110MD- CON		626	VON
1	EA	INTERFACE BOX	JB7			VON
1	EA	RIM CYLINDER	M3 CYLINDER AS REQUIRED		626	MED
1	EA	90 DEG OFFSET PULL	8190EZHD 10" O		630-316	IVE
1	EA	SURFACE CLOSER	4040XP HEDA		689	LCN
1	EA	FLOOR STOP	FS436/438 AS REQ'D		626	IVE
1	EA	BATTERY BACKUP	AS REQ BY SECURITY CONTRACTOR			SEC
1	EA	PORTAL GATEWAY	OMX-12811, PK-K-64			OSI
3	EA	WIRE HARNESS	CON-(LENGTH AS REQUIRED)			SCH
1	EA	DOOR CONTACT	7764		628	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 900-BBK 120/240 VAC			VON
1	EA	WIRING DIAGRAM	PROVIDE FACTORY POINT-TO- POINT WIRING DIAGRAM			VON

DOOR SEALS PROVIDED BY ALUMINUM FRAME MANUFACTURER.  
PORTAL GATEWAY QUANTITY AND LOCATION - FIELD VERIFY  
CARD READER AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.  
DOOR CONTACT AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.

HEADING 14

Each Assembly to have:

Qty	Description	Catalog Number	Finish	Mfr
1 EA	INSTITUTION LOCK	L9082L 06A	626	SCH
2 EA	MORTISE CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1 EA	SURFACE CLOSER	4040XP HEDA	689	LCN
1 EA	PROTECTION PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	FLOOR STOP	FS436/438 AS REQ'D	626	IVE

HINGES AND SEALS BY DOOR AND FRAME MANUFACTURER AS TESTED.

HEADING 15

1 SGL Door 110A CIRC / OFFICE  
36.000 X 84.000 X 1.750 X A/G X ALF X --

Each Assembly to have:

Qty	Description	Catalog Number	Finish	Mfr
1 EA	CONT. HINGE	224XY	628	IVE
1 EA	OFFICE W/IND.	L9050L 06A L583-363 L283-711	626	SCH
1 EA	MORTISE CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1 EA	OH STOP	100S	630	GLY
1 EA	SURFACE CLOSER	4040XP	689	LCN
1 EA	AUTO DOOR BOTTOM	369AA	AA	ZER

DOOR SEALS PROVIDED BY ALUMINUM FRAME MANUFACTURER.

HEADING 16

1 SGL Door 107A CIRC / STORAGE  
36.000 X 112.000 X 1.750 X WD X HMF X --

Each Assembly to have:

Qty	Description	Catalog Number	Finish	Mfr
4 EA	HINGE	3CB1 4.5 X 4.5	626	IVE
1 EA	STOREROOM LOCK	L9080L 06A	626	SCH
1 EA	MORTISE CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1 EA	SURFACE CLOSER	4040XP	689	LCN
1 EA	WALL STOP	WS401/402CCV	626	IVE
3 EA	SILENCER	SR64	GRY	IVE

**HEADING 17**

1 SGL Door 108A CIRC / RR  
36.000 X 112.000 X 1.750 X WD X HMF X --

Each Assembly to have:

Qty	Description	Catalog Number	Finish	Mfr
4 EA	HINGE	3CB1 4.5 X 4.5	626	IVE
1 EA	OFFICE W/IND.	L9050L 06A L583-363 L283-711	626	SCH
1 EA	MORTISE CYLINDER	M-3 PERMANENT CYLINDER	626	MED
1 EA	SURFACE CLOSER	4040XP EDA	689	LCN
1 EA	PROTECTION PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	FLOOR STOP	FS436/438 AS REQ'D	626	IVE
3 EA	SILENCER	SR64	GRY	IVE

**HEADING 18**

1 SGL Door 109A CIRC / LOUNGE  
36.000 X 84.000 X 1.750 X A/G X HMF X --

Each Assembly to have:

Qty	Description	Catalog Number	Finish	Mfr
1 EA	MOUNTING PLATE	4040XP-18 (AS REQUIRED)	689	LCN
1 EA	BLADE STOP SPACER	4040XP-61 (AS REQUIRED)	689	LCN
1 EA	CONT. HINGE	224XY	628	IVE
1 EA	OFFICE W/IND.	L9050L 06A L583-363 L283-711	626	SCH
1 EA	MORTISE CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1 EA	SURFACE CLOSER	4040XP	689	LCN
1 EA	FLOOR STOP	FS436/438 AS REQ'D	626	IVE
3 EA	SILENCER	SR64	GRY	IVE

**HEADING 19**

Each Assembly to have:

Qty	Description	Catalog Number	Finish	Mfr
3 EA	HINGE	3CB1 4.5 X 4.5	626	IVE
1 EA	STOREROOM LOCK	L9080L 06A	626	SCH
1 EA	MORTISE CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1 EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
3 EA	SILENCER	SR64	GRY	IVE
1 EA	DOOR CONTACT	7764	628	SCE

DOOR CONTACT AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.

**HEADING 20**

1 SGL Door 102B EXTERIOR / CLASSROOM  
1 SGL Door 103B EXTERIOR / CLASSROOM

36.000 X 84.000 X 1.750 X A/G X ALF X --

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	PA MOUNTING PLATE	4040XP-18PA (AS REQUIRED)	689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 (AS REQUIRED)	689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 (AS REQUIRED)	689	LCN
1	EA	CONT. HINGE	224XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-98-NL-OP-110MD-CON	626	VON
1	EA	INTERFACE BOX	JB7		VON
1	EA	RIM CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA	DOOR PULL	VR910 NL	630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	THRESHOLD	102A-223	A	ZER
1	EA	BATTERY BACKUP	AS REQ BY SECURITY CONTRACTOR		SEC
3	EA	WIRE HARNESS	CON-(LENGTH AS REQUIRED)		SCH
1	EA	MULTITECH READER	MTB15 5VDC - 28VDC	BLK	SCE
1	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 900-BBK 120/240 VAC		VON
1	EA	WIRING DIAGRAM	PROVIDE FACTORY POINT-TO-POINT WIRING DIAGRAM		VON

LOCK DOWN BUTTON SS2242LD-EN BY SECURITY CONTRACTOR  
CARD READER AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.  
DOOR CONTACT AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.

**HEADING 21**

1 SGL Door 125A ARCHITECTURE 3 / RECORDING

36.000 X 84.000 X 1.750 X WD X HMF X --

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	OFFICE W/IND.	L9050L 06A L583-363 L283-711	626	SCH
1	EA	MORTISE CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN

HINGES AND SEALS BY DOOR AND FRAME MANUFACTURER AS TESTED.

HEADING 22

1 SGL Door 128B STORAGE / ARCHITECTURE 4  
36.000 X 84.000 X 1.750 X WD X HMF X 20MIN

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080L 06A	626	SCH
1	EA	MORTISE CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP	689	LCN
1	EA	GASKETING	488SBK PSA (@ HEAD & JAMBS)	BK	ZER

HEADING 23

1 PR Door 144A ARCHITECTURE 3 / ARCHITECTURE 4  
72.000 X 84.000 X 1.750 X WD X HMF X 20MIN

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	FIRE/LIFE WALL MAG	SEM 7830	689	LCN
6	EA	HINGE	3CB1HW 4.5 X 4.5	652	IVE
1	EA	FIRE RATED REMOVABLE MULLION	KR9954	689	VON
1	EA	FIRE EXIT HARDWARE	PA-AX-98-EO-F	626	VON
1	EA	FIRE EXIT HARDWARE	PA-AX-98-L-F-2SI-06	626	VON
1	EA	RIM CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA	MORTISE CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA	ADA RIM CYL THUMBTURN	XB13-088 (-2SI)	626	SCH
2	EA	SURFACE CLOSER	4040XP EDA	689	LCN
2	EA	PROTECTION PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	SET	MEETING ASTRAGAL	328AA-S	AA	ZER
1	EA	GASKETING	488SBK PSA (@ HEAD & JAMBS)	BK	ZER
1	EA	THRESHOLD	102A-223	A	ZER

MORTISE CYLINDER FOR KR MULLION WITH REQUIRED CAM  
FIRE LIFE WALL MAGNET NEEDS TO BE WIRED INTO FIRE ALARM SYSTEM AND MUST RELEASE UPON ACTIVATION OF FIRE ALARM SYSTEM.

**HEADING 24**

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3CB1 4.5 X 4.5	626	IVE
1	EA	STOREROOM LOCK	L9080L 06A	626	SCH
1	EA	MORTISE CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA	SURFACE CLOSER	4040XP	689	LCN
1	EA	WALL STOP	WS401/402CCV	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

**HEADING 25**

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	MOUNTING PLATE	4040XP-18 (AS REQUIRED)	689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30 (AS REQUIRED)	689	LCN
2	EA	BLADE STOP SPACER	4040XP-61 (AS REQUIRED)	689	LCN
2	EA	CONT. HINGE	224XY	628	IVE
1	EA	REMOVABLE MULLION	5654	628	VON
1	EA	PANIC HARDWARE	CDSI-PA-AX-98-EO	626	VON
1	EA	PANIC HARDWARE	CDSI-PA-AX-98-NL-OP-110MD	626	VON
2	EA	MORTISE CYL TURN	09-900 114 XB11-720	626	SCH
1	EA	RIM CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
2	EA	LONG DOOR PULL	9266F 36" 20" STD	630-316	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN

DOOR SEALS PROVIDED BY ALUMINUM FRAME MANUFACTURER.

HEADING 26

1 SGL Door 127A EXTERIOR / IDF  
36.000 X 84.000 X 1.750 X HMD X HMF X --

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	PA MOUNTING PLATE	4040XP-18PA (AS REQUIRED)	689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 (AS REQUIRED)	689	LCN
1	EA	CONT. HINGE	224XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	EU MORTISE LOCK	L9092LEU 06A RX CON 12/24 VDC	626	SCH
1	EA	INTERFACE BOX	JB7		VON
1	EA	MORTISE CYLINDER	M-3 PERMANENT CYLINDER	626	MED
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	FLOOR STOP	FS436/438 AS REQ'D	626	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	102A-223	A	ZER
1	EA	BATTERY BACKUP	AS REQ BY SECURITY CONTRACTOR		SEC
3	EA	WIRE HARNESS	CON-(LENGTH AS REQUIRED)		SCH
1	EA	MULTITECH READER	MTB15 5VDC - 28VDC	BLK	SCE
1	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O
1	EA	WIRING DIAGRAM	PROVIDE FACTORY POINT-TO-POINT WIRING DIAGRAM		VON

LOCK DOWN BUTTON BY SECURITY CONTRACTOR SS2242LD-EN  
CARD READER AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.  
DOOR CONTACT AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.

HEADING 27

1 RU Door 124B EXTERIOR / ARCHITECTURE 3  
1 RU Door 124C EXTERIOR / ARCHITECTURE 3  
112.000 X 112.000 X 2.125 X A/G X ALF X --  
1 RU Door 129B EXTERIOR / ARCHITECTURE 4  
112.000 X 112.000 X 2.125 X A/G X HMF X --  
1 RU Door 128C STORAGE / ARCHITECTURE 4  
60.000 X 54.000 X 2.000 X STL X HMF X 20MIN

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	MORTISE CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
	EA	NOTE	HARDWARE BY ROLL UP DOOR MANUFACTURER		B/O

CONSULT ROLL UP DOOR MANUFACTURE FOR CYLINDER CAM REQUIREMENT  
BALANCE OF FINISH HARDWARE PROVIDE BY ROLL UP DOOR MANUFACTURER

HEADING 28

1 PR Door 130A ARCHITECTURE 4 / DUST COLL  
92.000 X 84.000 X 1.750 X HMD X HMF X 20MIN

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
6	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	SET	AUTO FLUSH BOLT	FB31P	630	IVE
1	EA	DUST PROOF STRIKE	DP1/2 AS REQ'D	626	IVE
1	EA	STOREROOM LOCK	L9080L 06A	626	SCH
1	EA	MORTISE CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	GASKETING	488SBK PSA (@ HEAD & JAMBS)	BK	ZER
1	EA	ASTRAGAL	44ST X 488SBK PSA	STST	ZER
1	EA	THRESHOLD	102A-223	A	ZER

HEADING 29

1 SGL Door 123B EXTERIOR / ARCHITECTURE 2  
1 SGL Door 124D EXTERIOR / ARCHITECTURE 3  
36.000 X 84.000 X 1.750 X A/G X ALF X --

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	PA MOUNTING PLATE	4040XP-18PA (AS REQUIRED)	689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 (AS REQUIRED)	689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 (AS REQUIRED)	689	LCN
1	EA	CONT. HINGE	224XY	628	IVE
1	EA	PANIC HARDWARE	LD-PA-AX-98-EO	626	VON
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	102A-223	A	ZER

DOOR SEALS PROVIDED BY ALUMINUM FRAME MANUFACTURER.



HEADING 30

1 PR Door 101A EXTERIOR / MEETING  
1 PR Door 101B EXTERIOR / MEETING

72.000 X 84.000 X 1.750 X A/G X ALF X --

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	224XY EPT	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	REMOVABLE MULLION	KR4954	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-98-EO-CON	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-98-NL-OP-110MD-CON	626	VON
1	EA	INTERFACE BOX	JB7		VON
1	EA	RIM CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA	MORTISE CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
		(MULLION)			
1	EA	DOOR PULL	VR910 DT	630	IVE
1	EA	DOOR PULL	VR910 NL	630	IVE
1	EA	AUTOMATIC OPERATOR	SW200I X MTG PLATES AS REQ	AL	BSM
2	EA	ACTUATOR	I36-3	630	WIK
1	SET	BOLLARD ACTUATOR	B-6SQ-RT-DB-SM-INGR		WIK
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	102A-223	A	ZER
1	EA	BATTERY BACKUP	AS REQ BY SECURITY CONTRACTOR		SEC
6	EA	WIRE HARNESS	CON-(LENGTH AS REQUIRED)		SCH
1	EA	MULTITECH READER	MTB15 5VDC - 28VDC	BLK	SCE
2	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 900-BBK 120/240 VAC		VON
1	EA	WIRING DIAGRAM	PROVIDE FACTORY POINT-TO-POINT WIRING DIAGRAM		VON

LOCK DOWN BUTTON BY SECURITY CONTRACTOR SS2242LD-EN  
CARD READER AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.  
DOOR CONTACT AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.  
VERIFY WITH ARCHITECT FOR ACTUATOR LOCATIONS AND WALL MOUNTED OR IF BOLLARD IS REQUIRED.

HEADING 31

1 PR Door 124A EXTERIOR / ARCHITECTURE 3  
72.000 X 84.000 X 1.750 X A/G X ALF X --

Each Assembly to have:

Qty	PR	Description	Catalog Number	Finish	Mfr
2	EA	PA MOUNTING PLATE	4040XP-18PA (AS REQUIRED)	689	LCN
2	EA	BLADE STOP SPACER	4040XP-61 (AS REQUIRED)	689	LCN
1	EA	CONT. HINGE	224XY	628	IVE
1	EA	CONT. HINGE	224XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	SET	AUTO FLUSH BOLT	FB31P	630	IVE
1	EA	DUST PROOF STRIKE	DP1/2 AS REQ'D	626	IVE
1	EA	EU MORTISE LOCK	L9092LEU 06A RX CON 12/24 VDC	626	SCH
1	EA	INTERFACE BOX	JB7		VON
1	EA	MORTISE CYLINDER	M-3 PERMANENT CYLINDER	626	MED
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4040XP HEDA	689	LCN
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	102A-223	A	ZER
1	EA	BATTERY BACKUP	AS REQ BY SECURITY CONTRACTOR		SEC
3	EA	WIRE HARNESS	CON-(LENGTH AS REQUIRED)		SCH
1	EA	MULTITECH READER	MTB15 5VDC - 28VDC	BLK	SCE
1	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O
1	EA	WIRING DIAGRAM	PROVIDE FACTORY POINT-TO-POINT WIRING DIAGRAM		VON

LOCK DOWN BUTTON BY SECURITY CONTRACTOR SS2242LD-EN  
CARD READER AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.  
DOOR CONTACT AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.

HEADING 32

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	PA MOUNTING PLATE	4040XP-18PA (AS REQUIRED)	689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 (AS REQUIRED)	689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 (AS REQUIRED)	689	LCN
1	EA	CONT. HINGE	224XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-98-NL-OP-110MD- CON	626	VON
1	EA	INTERFACE BOX	JB7		VON
1	EA	RIM CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA	90 DEG OFFSET PULL	8190EZHD 10" O	630-316	IVE
1	EA	SURFACE CLOSER	4040XP SHCUSH	689	LCN
1	EA	FLOOR STOP	FS436/438 AS REQ'D	626	IVE
1	EA	BATTERY BACKUP	AS REQ BY SECURITY CONTRACTOR		SEC
1	EA	PORTAL GATEWAY	OMX-12811, PK-K-64		OSI
3	EA	WIRE HARNESS	CON-(LENGTH AS REQUIRED)		SCH
1	EA	MULTITECH READER	MTB15 5VDC - 28VDC	BLK	SCE
1	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 900-BBK 120/240 VAC		VON
1	EA	WIRING DIAGRAM	PROVIDE FACTORY POINT-TO- POINT WIRING DIAGRAM		VON

DOOR SEALS PROVIDED BY ALUMINUM FRAME MANUFACTURER.  
PORTAL GATEWAY QUANTITY AND LOCATION - FIELD VERIFY  
CARD READER AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.  
DOOR CONTACT AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.

HEADING 33

1 SGL Door 118A EXTERIOR / IDF  
36.000 X 84.000 X 1.750 X HMD X HMF X --

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	PA MOUNTING PLATE	4040XP-18PA (AS REQUIRED)	689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 (AS REQUIRED)	689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 (AS REQUIRED)	689	LCN
1	EA	CONT. HINGE	224XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	EU MORTISE LOCK	L9092LEU 06A RX CON 12/24 VDC	626	SCH
1	EA	INTERFACE BOX	JB7		VON
1	EA	MORTISE CYLINDER	M-3 PERMANENT CYLINDER	626	MED
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	FLOOR STOP	FS436/438 AS REQ'D	626	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	102A-223	A	ZER
1	EA	BATTERY BACKUP	AS REQ BY SECURITY CONTRACTOR		SEC
3	EA	WIRE HARNESS	CON-(LENGTH AS REQUIRED)		SCH
1	EA	MULTITECH READER	MTB15 5VDC - 28VDC	BLK	SCE
1	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O
1	EA	WIRING DIAGRAM	PROVIDE FACTORY POINT-TO-POINT WIRING DIAGRAM		VON

LOCK DOWN BUTTON BY SECURITY CONTRACTOR SS2242LD-EN  
CARD READER AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.  
DOOR CONTACT AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.

HEADING 34

1 SGL Door E101A NORTH GATE  
36.000 X 87.000 X 1.750 X UNK X UNK X --

Each Assembly to have:


Qty		Description	Catalog Number	Finish	Mfr
1	EA	PA MOUNTING PLATE	4040XP-18PA SRI (AS REQUIRED)	689	LCN
1	EA	PA FLUSHTRANSOM BRKT	4040XP-419 SRI (AS REQUIRED)	689	LCN
1	EA	PANIC HARDWARE	CDSI-PA-AX-98-NL-OP-110MD	626	VON
1	EA	MORTISE CYL TURN	09-900 114 XB11-720	626	SCH
1	EA	RIM CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA	DOOR PULL	VR910 NL	630	IVE
1	EA	SURFACE CLOSER	4040XP EDA SRI	689	LCN
1	EA	FLOOR STOP	FS18S	BLK	IVE

BALANCE OF HARDWARE PROVIDED BY GATE MANUFACTURER.  
PROVIDE REINFORCEMENT AND MOUNTING PLATES FOR DOOR HARDWARE.

**HEADING 35**

1 SGL Door E101B NORTH GATE  
144.000 X 112.000 X 1.750 X UNK X UNK X --

Each Assembly to have:











Qty	Description	Catalog Number	Finish	Mfr
2	EA CANE BOLT - LOCKABLE	0524.00021 x 0524.00024		RIC

BALANCE OF HARDWARE PROVIDED BY GATE MANUFACTURER.

**HEADING 36**

1 SGL Door E101C NORTH GATE  
36.000 X 87.000 X 1.750 X UNK X UNK X --

Each Assembly to have:

Qty	Description	Catalog Number	Finish	Mfr
1	EA PA MOUNTING PLATE	4040XP-18PA SRI (AS REQUIRED)	 689	LCN
1	EA PA FLUSHTRANSOM BRKT	4040XP-419 SRI (AS REQUIRED)	 689	LCN
1	EA DOOR CORD	798C-18 WITH 20 GAUGE WIRES	 626	SCE
1	EA ELEC PANIC HARDWARE	RX-QELX-PA-AX-98-NL-OP-110MD-CON	 626	VON
1	EA INTERFACE BOX	JB7		VON
1	EA RIM CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA DOOR PULL	VR910 NL	 630	IVE
1	EA SURFACE CLOSER	4040XP EDA SRI	 689	LCN
1	EA FLOOR STOP	FS18S	 BLK	IVE
1	EA BATTERY BACKUP	AS REQ BY SECURITY CONTRACTOR		SEC
3	EA WIRE HARNESS	CON-(LENGTH AS REQUIRED)		SCH
1	EA MULTITECH READER	MTB15 5VDC - 28VDC	 BLK	SCE
1	EA DOOR CONTACT	7764	 628	SCE
1	EA POWER SUPPLY	PS902 900-2RS 900-BBK 120/240 VAC		VON
1	EA WIRING DIAGRAM	PROVIDE FACTORY POINT-TO-POINT WIRING DIAGRAM		VON

LOCK DOWN BUTTON BY SECURITY CONTRACTOR SS2242LD-EN  
CARD READER AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.  
DOOR CONTACT AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.

HEADING 37

1 PR Door E101D WEST GATE  
1 PR Door E101E SOUTHEAST GATE  
72.000 X 87.000 X 1.750 X UNK X UNK X --

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	DOOR CORD	798C-18 WITH 20 GAUGE WIRES	626	SCE
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-9827-EO-LBR	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-9827-NL-OP-LBR-110MD	626	VON
1	EA	INTERFACE BOX	JB7		VON
1	EA	RIM CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA	DOOR PULL	VR910 DT	630	IVE
1	EA	DOOR PULL	VR910 NL	630	IVE
2	EA	OH STOP & HOLDER	90H	630	GLY
2	EA	AUTOMATIC OPERATOR	SW200I X MTG PLATES AS REQ	AL	BSM
2	EA	ACTUATOR	I36-3	630	WIK
2	SET	BOLLARD ACTUATOR	B-6SQ-RT-DB-SM-INGR		WIK
1	EA	BATTERY BACKUP	AS REQ BY SECURITY CONTRACTOR		SEC
6	EA	WIRE HARNESS	CON-(LENGTH AS REQUIRED)		SCH
1	EA	MULTITECH READER	MTB15 5VDC - 28VDC	BLK	SCE
2	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 900-BBK 120/240 VAC		VON
1	EA	WIRING DIAGRAM	PROVIDE FACTORY POINT-TO-POINT WIRING DIAGRAM		VON

VERIFY SPECIFIED AUTO-OPERATOR AND ACCESSORIES ARE COMPATIBLE WITH GATE BALANCE OF HARDWARE PROVIDED BY GATE MANUFACTURER.  
PROVIDE REINFORCEMENT AND MOUNTING PLATES FOR DOOR HARDWARE.  
OUTSIDE ACTUATOR OPERATES RHR GATE. INSIDE ACTUATOR OPERATES LHR GATE  
CARD READER AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.  
DOOR CONTACT AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.  
110 V REQUIRED FOR AUTO OPERATOR

HEADING 38

1 SGL Door 119A EXTERIOR / PLANT SCIENCE  
1 SGL Door 120B EXTERIOR / HORTICULTURE

36.000 X 84.000 X 1.750 X A/G X ALF X --

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	PA MOUNTING PLATE	4040XP-18PA (AS REQUIRED)	689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 (AS REQUIRED)	689	LCN
1	EA	CONT. HINGE	224XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-98-NL-OP-110MD-CON	626	VON
1	EA	INTERFACE BOX	JB7		VON
1	EA	RIM CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA	DOOR PULL	VR910 NL	630	IVE
1	EA	SURFACE CLOSER	4040XP SHCUSH	689	LCN
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	102A-223	A	ZER
1	EA	BATTERY BACKUP	AS REQ BY SECURITY CONTRACTOR		SEC
3	EA	WIRE HARNESS	CON-(LENGTH AS REQUIRED)		SCH
1	EA	MULTITECH READER	MTB15 5VDC - 28VDC	BLK	SCE
1	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 900-BBK 120/240 VAC		VON
1	EA	WIRING DIAGRAM	PROVIDE FACTORY POINT-TO-POINT WIRING DIAGRAM		VON

LOCK DOWN BUTTON BY SECURITY CONTRACTOR SS2242LD-EN  
CARD READER AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.  
DOOR CONTACT AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.

HEADING 39

1 SGL Door 119B EXTERIOR / PLANT SCIENCE  
1 SGL Door 120A EXTERIOR / HORTICULTURE

36.000 X 84.000 X 1.750 X A/G X ALF X --

Each Assembly to have:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	PA MOUNTING PLATE	4040XP-18PA (AS REQUIRED)	689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 (AS REQUIRED)	689	LCN
1	EA	CONT. HINGE	224XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-98-NL-OP-110MD-CON	626	VON
1	EA	INTERFACE BOX	JB7		VON
1	EA	RIM CYLINDER	M3 CYLINDER AS REQUIRED	626	MED
1	EA	DOOR PULL	VR910 NL	630	IVE
1	EA	SURFACE CLOSER	4040XP HEDA	689	LCN
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	102A-223	A	ZER
1	EA	BATTERY BACKUP	AS REQ BY SECURITY CONTRACTOR		SEC
3	EA	WIRE HARNESS	CON-(LENGTH AS REQUIRED)		SCH
1	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 900-BBK 120/240 VAC		VON
1	EA	WIRING DIAGRAM	PROVIDE FACTORY POINT-TO-POINT WIRING DIAGRAM		VON

LOCK DOWN BUTTON BY SECURITY CONTRACTOR SS2242LD-EN  
CARD READER AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.  
DOOR CONTACT AND WIRING BY DIVISION 28 SECURITY CONTRACTOR.

END OF SCHEDULE



LBCC -Construction Trades II

**Catalog Cuts**

For

**LBCC -Construction Trades II**

**Sorted By DHI Sequence**

**Prepared By**

**Justin Hite**

**Created On 12/21/2021**

Generated By



## LBCC -Construction Trades II

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MED	M3 CYLINDER AS REQUIRED	RIM CYLINDER	NA	
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# 4040XP Series

## Accessories

### Cylinders



**4040XP-3071**  
Cast Iron Cylinder Assembly

- Non-handed
- Heavy duty



**4041-3071 DEL**  
Cast Iron Cylinder Assembly

- Used for delayed action closing
- Non-handed
- Heavy duty

### Covers



**4040XP-72**  
Plastic Cover

- Includes 4040XP-54 snap-on cover clip
- Non-handed
- Standard



**4040XP-72MC**  
Metal Cover

- Handed
- Required for plated finishes and custom powder coat finishes
- Optional

### Installation Accessories



**4040XP-18**  
Plate

- Required for hinge side mount where top rail is less than 3-3/4" (95 mm)
- Requires minimum 2" (51 mm) minimum top rail



**4040XP-18G**  
Plate

- Locates top jamb mounted closer flush with top of head frame face in flush ceiling condition
- Requires 1-3/4" (44 mm) minimum head frame



**4040XP-18TJ**  
Plate

- Centers top jamb mounted closer vertically on head frame where face is less than 3-1/2" (89 mm). Plate requires 1-3/4" (44 mm) minimum head frame



**4040XP-18PA**  
Plate

- Required for parallel arm mounting where top rail is less than 5-1/2" (140 mm), measured from the stop
- Requires 2" (51 mm) minimum top rail



**4040XP-62PA**  
PA Shoe

- Required for parallel arm mounting

# 4040XP Series

## Accessories

### Installation Accessories cont.



#### 4040XP-30 CUSH Shoe Support

- Provides anchorage for fifth screw used with CUSH arms, where reveal is less than 3-1/16" (78 mm)
- Optional



#### 4040XP-61 Blade Stop Spacer

- Required to lower parallel arm shoe to clear 1/2" (13 mm) blade stop
- Optional



#### 4040XP-419 PA Flush Panel Adapter

- Provides horizontal mounting surface for parallel arm shoe on single rabbeted or flush frame
- Optional



#### 4040XP-62A Auxiliary Shoe

- Requires a top rail of 7" (178 mm)
- Shoe replaces -62PA for parallel arm mounting of regular arm with overhead holder/stop
- Optional

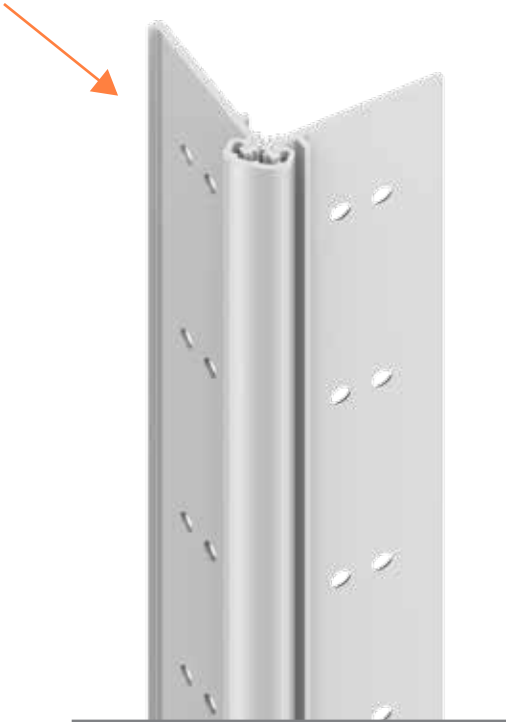


#### 4040XP-54 Snap-On Cover Clip

- Used to secure 4040XP-72 Plastic Cover to cylinder body



## Aluminum Geared Hinges



### 224XY Full Mortise - Door Edge Protector

UL10C certified

Meets ANSI 156.26 for 150 lbs and 300 lbs.

- For 1 3/4" Doors
- Door Edge Protector
- Patented center loaded, interlocking bearing design
- Non Handed for custom cut lengths
- 1/16" door inset
- 48" Maximum Door Width
- Beveled or Square Edge Doors
- Frame guidance lip is extended further for retrofit applications to cover existing heavy weight architectural hinge preps
- For doors weighing up to 450 pounds without reinforcing, 600 pounds with reinforcing
- For lead-lined application consult factory for engineering specials

Standard lengths 83", 85", 95", 119"

#### Standard Mounting Hardware

12-24 x 3/4" Steel Self Drilling / Self Tapping Phillips Head Screw

#### Finishes

Clear Anodized (US28), Dark Bronze Anodized (313AN)

Custom Anodizing and Painting are available, consult factory

#### Options:

HT	Hospital Tip
EPT	Electric Power Transfer
TWP CON	Electrical Through Wire Panel with Allegion Connect

#### Optional Mounting Hardware:

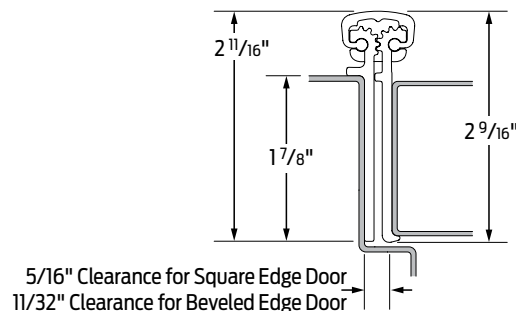
TEK/WD	1/2 Self Drill, Self Tap 1/2 Wood
WD	Wood Door and Frame

#### Available Accessory Kits:

Security Screws - Hollow Metal  
Security Screws - Wood  
Thread Forming Screws

#### For Single Door Applications

For pairs of doors see chart and general information



# Architectural Hinges **IVES**



Meets ANSI/BHMA A156.1  
A8133 – Steel  
A5133 – Stainless Steel  
A2133 – Brass

## 3PB1 3 Knuckle, Plain Bearing Full Mortise Hinge

- For standard weight doors
- Low frequency usage
- Packed with wood and metal screws

*Not for use with a door closer.*

### Options

- NRP, Non-Removable Pin
- SH, Security Stud
- HT, Hospital Tip
- RC, Round Corners - 1/4" or 5/8" Radius
- SEC, Security Fasteners - Pin-in-Socket

### Dimensions

Size (Inches)	Size (mm)	Gauge
3.5 x 3.5	90 x 90	0.134
4 x 4	102 x 102	0.134
4.5 x 4	114 x 102	0.134
4.5 x 4.5	114 x 114	0.134
5 x 4.5	127 x 114	0.134



Meets ANSI/BHMA A156.1  
A8112 – Steel  
A5112 – Stainless Steel  
A2112 – Brass

## 3CB1 3 Knuckle, Concealed Bearing Full Mortise Hinge

- For standard weight doors
- Medium frequency usage
- Packed with wood and metal screws

### Options

- NRP, Non-Removable Pin
- SH, Security stud
- HT, Hospital Tip
- RC, Round Corners - 1/4" or 5/8" Radius
- SEC, Security Fasteners - Pin-in-Socket

### Dimensions

Size (Inches)	Size (mm)	Gauge
3.5 x 3.5	90 x 90	0.134
4 x 4	102 x 102	0.134
4.5 x 4	114 x 102	0.134
4.5 x 4.5	114 x 114	0.134
5 x 4.5	127 x 114	0.134

### Finishes *brass*

Ives Finish	US3	US4	US10	US10B	US10A	US11	US15	US26	US26D
BHMA	605	606	612	613	614	616	619	625	626

### Finishes *steel*

Ives Finish	USP	US3	US4	US10	US10B	US10A	US11	US15	US26	US26D
BHMA	600	632	633	639	640	641	643	646	651	652

### Finishes *stainless steel*

Ives Finish	US32	US32D
BHMA	629	630

Hinges & Pivots  
**A5**

Pulls & Plates  
**B**

Flush Bolts & Coordinators  
**C**

Latches, Catches & Bolts  
**D**

Stops  
**E**

Exterior Hardware  
**F**

Miscellaneous Hardware  
**G**



# IVES® Architectural Hinges

A6

Hinges &amp; Pilots



## 3CB1HW 3 Knuckle, Concealed Bearing Full Mortise Hinge

- For heavy weight doors
- High frequency usage
- Packed with wood and metal screws

### Options

- NRP, Non-Removable Pin
- SH, Security stud
- HT, Hospital Tip
- RC, Round Corners - 1/4" or 5/8" Radius
- SEC, Security Fastners - Pin-in-Socket

### Dimensions

Size (Inches)	Size (mm)	Gauge
4.5 x 4	114 x 102	0.180
4.5 x 4.5	114 x 114	0.180
5 x 4.5	127 x 114	0.190
5 x 5	127 x 127	0.190

Meets ANSI/BHMA A156.1  
A8112 – Steel  
A5112 – Stainless Steel  
A2112 – Brass

B

Pulls &amp; Plates

C

Flush Bolts &amp; Coordinators



## 3SP1 3 Knuckle Spring Full Mortise Hinge

- For automatic closing of doors
- Packed with wood and metal screws

### Options

- HT, Hospital Tip
- RC, Round Corners - 1/4" or 5/8" Radius
- SEC, Security Fastners - Pin-in-Socket

### Dimensions

Size (Inches)	Size (mm)	Gauge
4 x 4	102 x 102	0.134
4.5 x 4	114 x 102	0.134
4.5 x 4.5	114 x 114	0.134

Meets ANSI/BHMA A156.7  
K81071F – Steel  
K51071F – Stainless Steel  
UL listed for use with fire rated doors

E

Stops

F

Exterior Hardware

### Finishes *brass*

Ives Finish	US3	US4	US10	US10B	US10A	US11	US15	US26	US26D
BHMA	605	606	612	613	614	616	619	625	626

### Finishes *steel*

Ives Finish	USP	US3	US4	US10	US10B	US10A	US11	US15	US26	US26D
BHMA	600	632	633	639	640	641	643	646	651	652

### Finishes *stainless steel*

Ives Finish	US32	US32D
BHMA	629	630

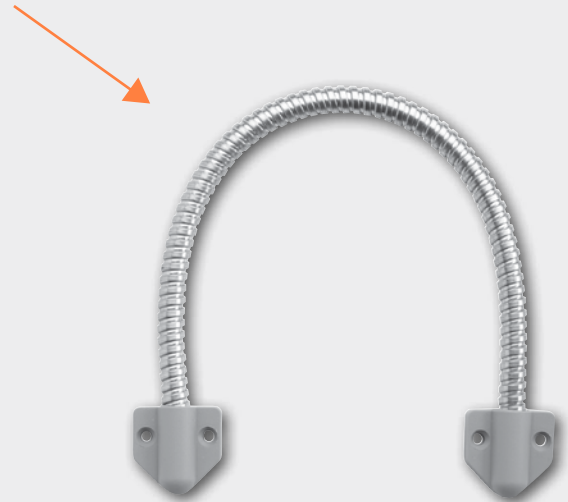
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Miscellaneous Hardware

A6



# Armored door cords with caps



## Overview

Used when installing electric exit devices or electric locks, armored door cords provide a simple and economical solution for transferring power from frame to door.

## Specifications

### Acceptable wire size combinations

- Five 18 gauge
- Two 18 gauge and four 20 gauge
- Two 18 gauge and seven 22 gauge
- Seven 20 gauge
- Twelve 22 gauge

### $\frac{5}{16}$ " interior diameter; $\frac{3}{8}$ " outside diameter flexible door cord

- **788-12** - 12" x  $\frac{3}{8}$ " less wires (inswinging)
- **788C-12** - 12" x  $\frac{3}{8}$ " with 20" 4-conductor wire, 20 gauge wire
- **788-18** - 18" x  $\frac{3}{8}$ " less wires (outswinging)
- **788C-18** - 18" x  $\frac{3}{8}$ " with 26" 4-conductor wire, 20 gauge wire

### $\frac{3}{8}$ " interior diameter; $\frac{1}{2}$ " outside diameter flexible door cord

#### Acceptable wire size combinations

- **798-12** - 12" x  $\frac{1}{2}$ " less wires (inswinging)
- **798C-12** - 12" x  $\frac{1}{2}$ " with 20" 4-conductor wire, 20 gauge wire
- **798-18** - 18" x  $\frac{1}{2}$ " less wires (outswinging)
- **798C-18** - 18" x  $\frac{1}{2}$ " with 26" 4-conductor wire, 20 gauge wire

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## About Allegion

Allegion (NYSE: ALLE) is a global pioneer in safety and security, with leading brands like CISA®, Interflex®, LCN®, Schlage® and Von Duprin®. Focusing on security around the door and adjacent areas, Allegion produces a range of solutions for homes, businesses, schools and other institutions. Allegion is a \$2 billion company, with products sold in almost 130 countries. For more, visit [www.allegion.com](http://www.allegion.com).

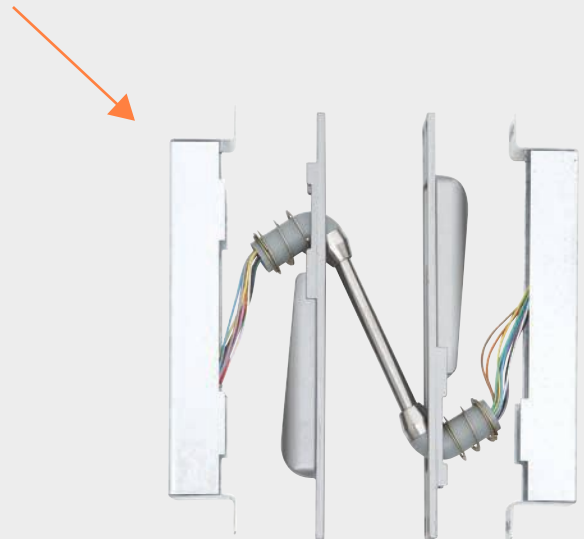
aptiQ ■ LCN ■  ■ STEELCRAFT ■ VON DUPRIN



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**VON DUPRIN®**

## Electrical power transfer



### Overview

Electric power transfer provides a means of transferring electrical power from a door frame to the edge of a swinging door. The units are completely concealed when the door is in the closed position, and are ideally suited for installations involving abuse or heavy traffic.

Two models are available; EPT-2, two 18 gauge wires and EPT-10, ten 24 gauge wires.

### Features and benefits

- UL Listed for use on fire doors
- UL listed as Miscellaneous Door Accessory
- Ball-and-socket joint construction provides cut and pinch protection for wiring
- Built for heavy traffic and high abuse openings

## Door applications

- Up to 5" butt hinges – 180° swing.
- 5 1/2" butt hinges – 130° swing.
- 6" butt hinges – 110° swing.
- 3/4" offset pivots – 180° swing.

Not for use with swing clear hinges, center-hung pivots, pocket pivots or balanced doors.

Door applications shown are for 1 3/4" door thickness, for all other applications contact Technical Support to confirm compatibility.

## Finishes

- SP28 (sprayed aluminum)
- SP313 (sprayed duranodic)

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### Dimensions

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Housing	9" X 1 1/4" X 1 5/8" (229mm X 32mm X 38mm)
EPT-2	Two 18 gauge wires, up to 2 AMPS @ 24VDC, with a 16 AMPS maximum surge
EPT-10	Ten 24 gauge wires, up to 1 AMPS @ 24VDC, with a 16 AMPS maximum surge
PNT-1	5/32" tubing

---

### To order, specify

- **EPT-2, EPT-10 or PNT-1.**
- **Finish, SP28 or SP313.**

## About Allegion

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**IVES****Automatic Flush Bolts –  
Metal Doors****A**  
Hinges & Pivots**B**  
Pulls & Plates**C2**  
Flush Bolts & Coordinators**D**  
Latches, Catches & Bolts**E**  
Stops**F**  
Exterior Hardware**G**  
Miscellaneous Hardware

Meets ANSI A156.3 Type 25.  
UL Listed 3 Hour Fire Doors 8'0" x 10'0"



Meets ANSI A156.3 Type 25.  
UL Listed 3 Hour Fire Doors 8'0" x 8'0"

**FB31P Top and Bottom Bolts (Pair)**

- Fully Automatic—inactive door is latched, bolts are extended when active door closes, door is unlatched, bolts retract when active door is opened.
- Low Actuation Forces—Top Bolt Has No Spring Tension.
- Fits standard ANSI A115.4 Door Frame Preparations.
- Non-handed.
- Bolt throw is 3/4" with a 7/8" vertical adjustment.
- Bolt backset is 3/4"
- Standard Rod Length is 12", which is measured from the center of the flush bolt body to the bolt tip. Optional rod lengths available for top bolt only on non-fire rated openings—18", 24", 36" and 48.

*DP1 or DP2 optional dust proof strike available, see page C11.*

**FB31T Top Bolt Only  
FB31B Bottom Bolt Only****FB32 Top Bolt with Auxiliary Fire Latch**

- FB32 Model with Auxiliary Fire Latch eliminates the bottom bolt and is UL Listed for Fire Doors.

**FB33 Top Bolt with Auxiliary Fire Latch and Retrofit Plate**

- FB33 Model with Auxiliary Fire Latch eliminates the bottom bolt and includes a retrofit plate to cover existing bottom bolt prep. UL Listed for Fire Doors.

**Dimensions**

Body Size: 1" Wide x 6-3/4" Long x 2" Deep

Guide Size: 1" Wide x 1-27/32" Long x 27/32" High x 3/32" Thick

Strike Size: 15/16" Wide x 2-1/4" Long x 1/16" Thick

Rub Plate Size: 1-1/4" Wide x 1-11/16" Long x 3/64" Thick

Auxiliary Fire Latch Size: 1" Wide x 1-3/4" Long x 3-1/4" Deep

Retrofit Plate Size: 1" Wide x 6-3/4" Long x 3/32" Thick

**Finishes**

Ives Number	US3	US4	US10	US10B	US32	US32D
BHMA	605	606	612	613	629	630

**C2**

**IVES****Constant Latching Flush Bolts –  
Metal Doors****A**  
Hinges & Pivots**B**  
Pulls & Plates**C4**  
Flush Bolts & Coordinators**D**  
Latches, Catches & Bolts**E**  
Stops**F**  
Exterior Hardware**G**  
Miscellaneous Hardware

Top Bolt

Bottom Bolt

Meets ANSI A156.3 Type 27.  
UL Listed 3 Hour Fire Doors 8'0" x 10'0"

**FB51P Top and Bottom Bolts (Pair)**

- Constant Latching—inactive door remains latched until the active door is opened, releasing the automatic bottom bolt and then the top bolt can be manually released. Inactive door will relatch automatically when closed.
- Low Actuation Forces.
- Fits standard ANSI A115.4 Door and Frame Preparations.
- Non-handed.
- 3/4" bolt throw with a 7/8" vertical adjustment.
- 3/4" backset
- Standard Rod Length is 12", which is measured from the center of the flush bolt body to the bolt tip. Optional rod lengths available for top bolt only on non-fire rated openings—18", 24", 36" and 48".

*DP1 or DP2 optional dust proof strike available, see page C11.*

**FB51T Top Bolt Only****FB52 Top Bolt with Auxiliary Fire Latch**

- FB52 Model with Auxiliary Fire Latch eliminates the bottom bolt and is UL Listed for Fire Doors.

**FB53 Top Bolt with Auxiliary Fire Latch & Retrofit Plate**

- FB53 Model with Auxiliary Fire Latch eliminates the bottom bolt and includes a retrofit plate to cover existing bottom bolt prep. UL Listed for Fire Doors.



Top Bolt

Auxiliary Fire Latch

Meets ANSI A156.3 Type 27.  
UL Listed 3 Hour Fire Doors 8'0" x 10'0"

**Dimensions**

Body Size: 1" Wide x 6-3/4" Long x 2" Deep

Guide Size: 1" Wide x 1-27/32" Long x 11/16" High x 3/32" Thick

Strike Size: 15/16" Wide x 2-1/4" Long x 1/16" Thick

Rub Plate Size: 1-1/4" Wide x 1-11/16" Long x 3/64" Thick

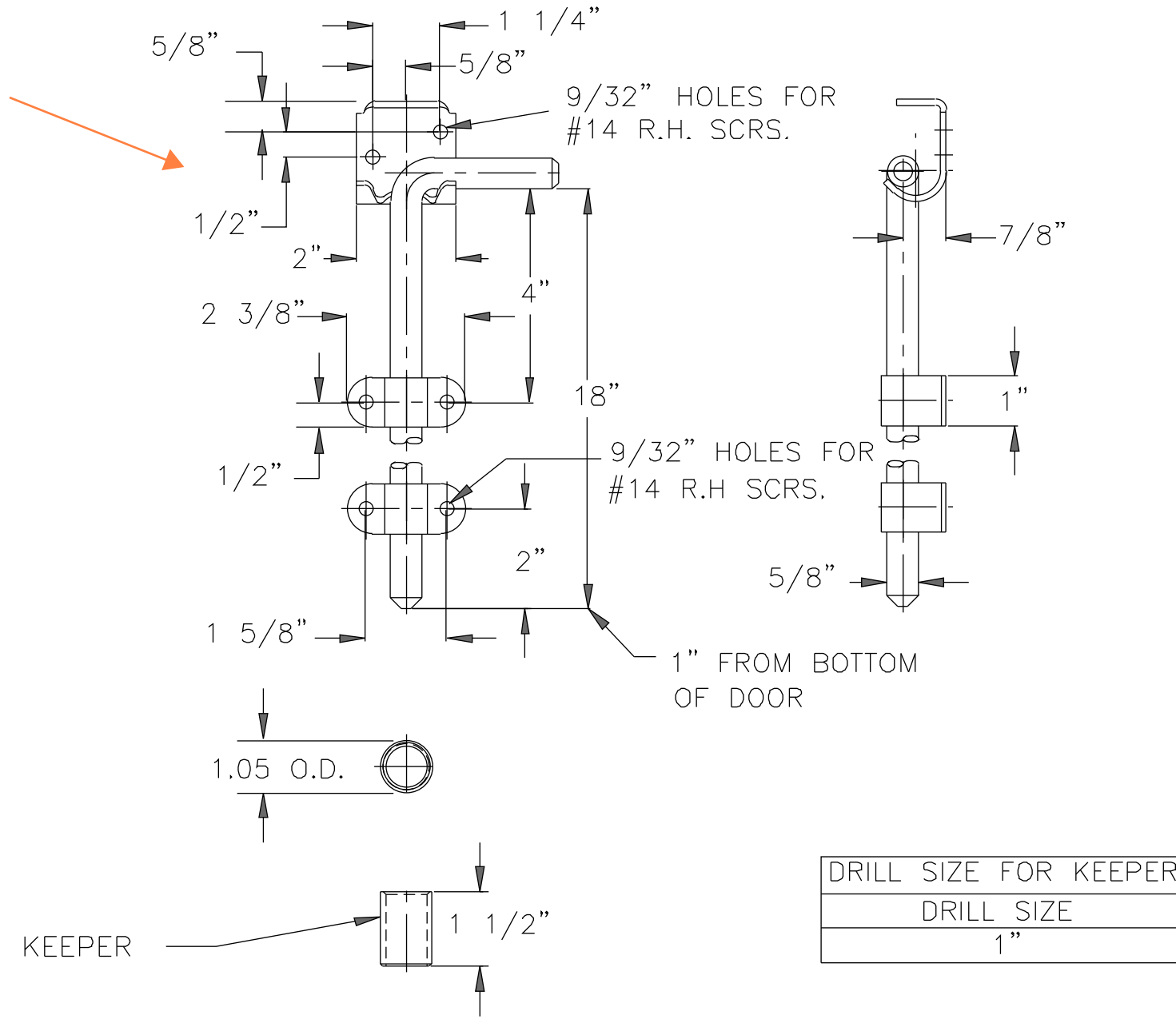
Auxiliary Fire Latch Size: 1" Wide x 1-3/4" Long x 3-1/4" Deep

Retrofit Plate Size: 1" Wide x 6-3/4" Long x 3/32" Thick

**Finishes**

Ives Number	US3	US4	US10	US10B	US32	US32D
BHMA	605	606	612	613	629	630

**C4**





# Dust Proof Strikes **IVES**



DP1



DP2

Meets Meets ANSI/BHMA 156.16, L14011.

## DP1 DP2 Dust Proof Strikes

- Designed for use with the bottom bolt of all flush bolts.
- Spring-loaded plunger returns to floor or threshold level anytime flush bolt is retracted, eliminating need to clean standard floor strikes.
- Strike hole is 3/4" Diameter and 1-1/8" Deep

### Dimensions

DP1 Face Plate: 1-7/16" Diameter

DP2 Face Plate: 1-5/8" W x 3-1/2" L x 1/8" Thick

Body: 1-3/16" Diameter x 1-7/8" Deep

### Finishes

Ives Number	US3	US4	US10	US10B	US26	US26D
BHMA	605	606	612	613	625	626

Hinges & Pivots  
**A**

Pulls & Plates  
**B**

Flush Bolts & Coordinators  
**C11**

Latches, Catches & Bolts  
**D**

Stops  
**E**

Exterior Hardware  
**F**

Miscellaneous Hardware  
**G**

**C11**

# Mullions

## Mullions

**Removable steel mullions** Mullions provide single door performance in double door openings with rim devices. Mullions are easily removed by loosening bottom set screw and removing top fitting cover. The top mullion fitting is attached to the frame and is concealed by the fitting cover.

Steel mullions are 2" (51mm) wide and 3" (76mm) deep, with a wall thickness of  $\frac{1}{8}$ " (3mm).

Mullions are shipped with mounting screws and prepared for strikes. Strikes are not included except where indicated.

Steel mullions are available in SP28 and SP313 finishes. Consult factory for other powder coat finish options.

**KR – Keyed removable steel mullions** makes removal faster and easier by a single operation of the mortise cylinder. Once mullion is removed, large equipment or furniture can freely pass through the opening. The unit will self lock when re-installed, without use of the cylinder key. Uses a  $1\frac{1}{4}$ " mortise cylinder with a straight cam (Schlage cam reference B502-191). Cylinders are sold separately. Prefix mullion model with "KR".

**Removeable aluminum mullions** are  $1\frac{1}{16}$ " (27mm) wide on face closest to the door and  $2\frac{3}{8}$ " (60mm) at the widest point. The depth is  $3\frac{1}{8}$ " (79mm) with a wall thickness of  $\frac{1}{8}$ " (3mm).

Aluminum mullions are available in US4, US10, US28, 313 and 315 finishes. Consult factory for other powder coat finish options.

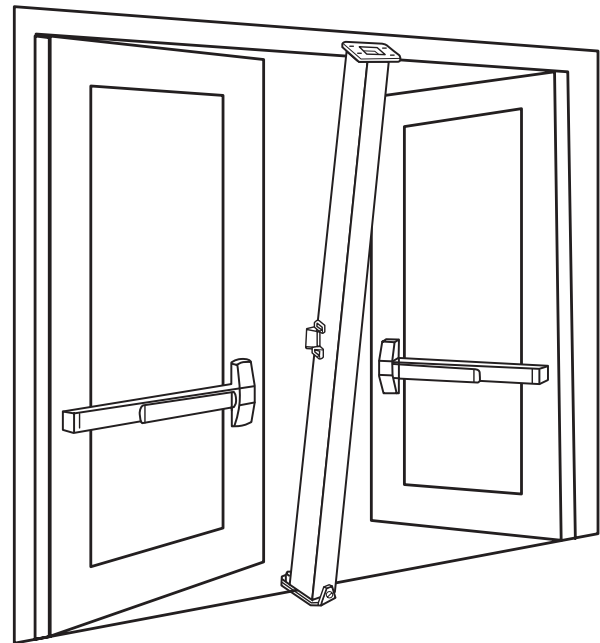
Stock Hollow Metal Applications for devices mounted to cover ANSI 161 cutouts are higher than the standard mullion strike location. Consult the factory for special strike preparation or order a blank mullion. See below.

Blank Mullions are furnished without strike preparation. They are used to mount devices at a strike height different from the standard mullion preparation.

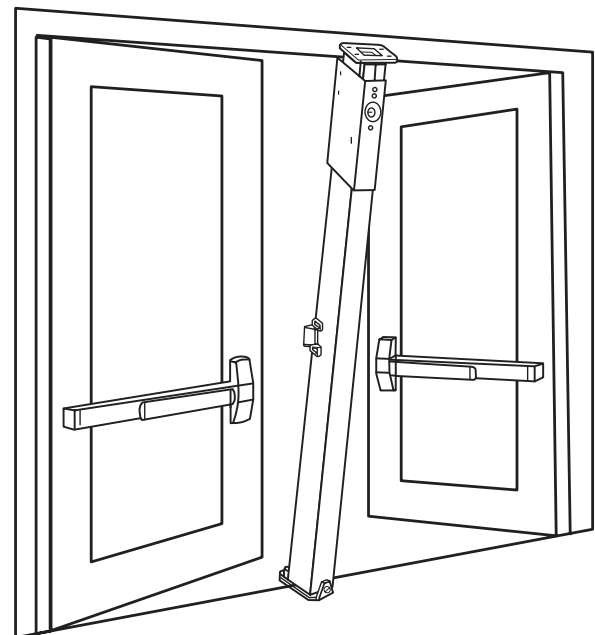
### To order, specify:

1. For keyed Removable option on steel mullions, prefix model number with "KR"
2. Model number.
3. Height of opening
4. Finish
5. Handing if required.
6. Centerline deviation (refer to device template for standard centerline).
7. Strikes, when required, should be ordered with device.
8. For keyed Removable option on steel mullions, prefix model number with "KR"

Removable mullions



Keyed removable steel mullions




# Mullions

## Steel mullions

**1654** Prepared for two 1606 strikes. **If 1606 strikes are not specified on the order, two per mullion will be added. Additional charges apply.**

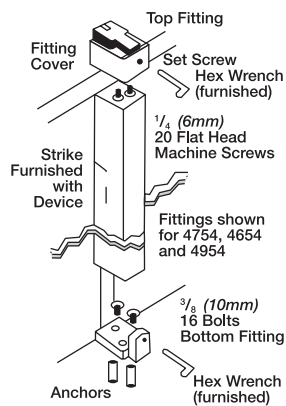
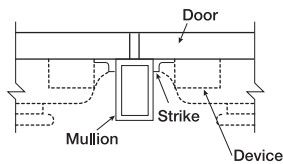
**4954** Prepared for 264 or 299 strikes. For use with all Von Duprin Panic rim devices. **Note: specify strike choice with device.**

 **9954** Prepared for and must be used with two 268 strikes (88-F device), or two 499F (22-F, 98-F, 99F devices). UL fire labeled mullion for up to 3 hour opening using Von Duprin fire exit rim devices. This mullion is not easily removed due to special fittings.

22-F and 88-F devices are rated up to 8' x 8" (2438mm x 2438mm).


98-F and 99-F devices are rated up to 10'0" (3048mm).

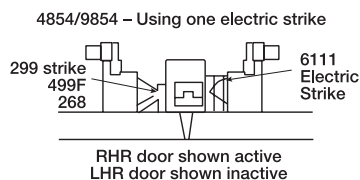
**Note:** If 268 or 499F strikes are not specified on the order, two per mullion will be added. Additional charges apply.



**4754** Prepared for two 4263 monitor strikes.

**4854** Prepared for one 299 and one 6111 electric strike. Indicate handing for electric strike.

 **9854** Prepared for one 268 or 499F strike and one 6111 electric strike. Indicate handing for electric strike. UL fire labelled mullion for up to 3 hour openings up to 8' x 8' (2438mm x 2438mm) using Von Duprin Fire Exit Rim Devices



## Aluminum mullions

**5654** Prepared for two 264 or 299 strikes with weatherstripping. Includes one set of 154 stabilizers.

**5754** Prepared and furnished with one 1408 double door strike. Includes one 154 stabilizer set. Note: specify device "less strike".

### Sizes for mullions

1654, 4954, 4754, 4854, 5654	9854, 9954
7' 2" (2184mm)	7' 3" (2210mm)
*8' 2" (2489mm)	8' 3" (2475mm)
*10' 2" (3099mm)	10' 3" (3124mm)

**KR1654, KR4954, KR4754, KR4854** **KR9854\*\*, KR9954\*\*\***

7' 6" (2286mm)	7' 5" (2261mm)
8' 6" (2591mm)	*8' 5" (2565mm)
10' 6" (3200mm)	*10' 5" (3175mm)

\* Only qualifying applications will be provided with UL Label.

\*\* Fire rated same as 9854

\*\*\* Fire rated same as 9954

**Angle plate** is used with narrow transom frames. The plate attaches to the transom extending the surface area needed to mount the mullion. Must be ordered separately. Specify finish.



**154 Stabilizer** is a two-piece interlocking set. One piece mounts on the mullion with the top mounting hole 5<sup>3</sup>/<sub>16</sub>" (148mm) below the centerline of the strike; the other piece mounts on the door. Shims are provided to adjust for misalignment between the door and mullion.

The set maintains integrity between the door and mullion to prevent vandalism and to ensure contact between the device and strike as the doors expand and contract with temperature changes.

Furnished standard on aluminum mullions; optional for steel and all blank steel mullions.



**MT54 Storage kit** is a set of floor and wall brackets that provide convenient storage of the keyed removable mullion when removed from the opening.

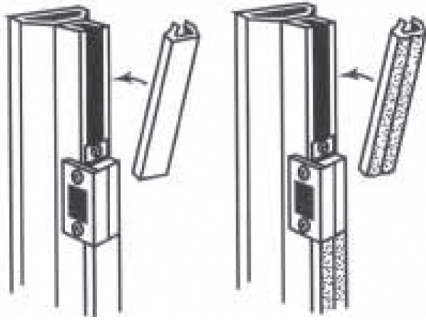
### To order, specify

1. Model MT54.
2. Finish SP28, SP313, or SPBLK

# Weatherstripping

## Weatherstripping

Weatherstripping prevents cold air from blowing between doors and mullion. It also serves as a silencer when the door is closed against the mullion. The silicone treated weatherstrip pile is bonded to a polypropylene backing. A slide-in molding houses the weatherstripping, covers mounting screws of the strike and extends to both the top and bottom of the mullion. Available on aluminum mullions only.



Standard edging

Edging with weatherstripping



## L909x Series

### Electrified mortise lock



### Overview

The most complex electronic access systems still rely on mechanical hardware to operate properly. Advanced electronic technology can go to waste without adequate mechanical locking strength and functionality.

The Schlage L909x series of electrified mortise locks serves as the mechanical component to an electrified locking solution. The lock can be integrated into an electronic access control system or be used as a stand-alone solution with a buzzer or other device as the controller.

The L909x series offers exceptional flexibility and power savings. The lock automatically adapts to 12 or 24V DC input, and a case-mounted switch allows selection between EL and EU operation. Request to exit is modular and can be added without opening the lock case. 0.4amps maximum current draw allows multiple units on a single power supply, while 0.01amps holding current eliminates "hot levers" in EL applications.

Utilizing the same levers, trims and options as the Schlage L-series mortise, the L909x integrates as seamless with the mechanical component of the project as the electronic. And because it is based on the Schlage L mortise, it carries the same proven record of performance, strength and durability from the most trusted name in the industry.

#### Recommended applications

The L909x Series Electrified Mortise Lock is useful for many applications, including but not limited to:

- Security control centers
- Cashier rooms
- Fire safety exits
- Equipment rooms
- Hazardous material storage

### Features and benefits

- Universal input voltage- accepts 12 or 24V DC for installation flexibility
- User selectable fail safe/fail secure through use of switch on lock case
- Low maximum current draw allows multiple locks on a single power supply
- Low holding current produces minimal heat, eliminating "hot levers" in electrically locking applications
- Modular RX design allows RX to be added at a later time without opening the lock case
- UL listed for 3 hour fire door

#### Available Options:

- Request to Exit (RX)
- Latchbolt Monitor (LX)
- Door Position Sensor (DPS)
  - non-deadbolt functions only
- Deadbolt Monitor (DM)
  - deadbolt functions only

## L Series mechanical specifications

Handing	Field reversible
Door thickness	1 3/4" (44 mm) standard, 1 3/8" (35 mm) to 2 1/2" (64 mm) optional. Over 2 1/2" (64 mm) door ranges vary by function. Specify door thickness other than 1 3/4".
Backset	2 3/4" (70 mm) only
Armored front	Standard: 1 1/4" x 8" x 7/32" (32 mm x 203 mm x 6 mm) Optional: 1 1/16" x 8" x 7/32" (27 mm x 203 mm x 6 mm)
Case size	4 7/16" x 6 1/16" x 1" (113 mm x 154 mm x 25 mm)
Spacing	Knob or lever to cylinder, 3 7/8" (98 mm); knob or lever to thumbturn hub, 2 11/16" (68 mm)
Bolts	1" (25 mm) throw stainless steel deadbolt and 3/4" (19 mm) throw stainless steel latch with anti-friction tongue
Cylinders and keys	6-pin solid brass cylinder is standard with Everest 29 S123 keyway furnished as default. Furnished with 2 nickel silver keys. Additional Schlage keyways available.
Keying options	Available in full size interchangeable core (FSIC) and small format interchangeable core (SFIC). Also available less cylinder and less FSIC to allow for Primus XP cylinder usage.
Strike	ANSI curved lip strike 1 1/4" x 4 7/8" (32 mm x 124 mm) x 1 3/16" (30 mm) lip to center with dust box standard
Trim	Three rose (sectional) trims and two escutcheon trims
Levers	30 available lever designs

## L Series electronic specifications

Voltage	Auto-detects 12/24V DC operation
Peak current	0.4 amps
Holding current	0.010 amps
Operating temperature	Maximum +140°F (+60°C) Minimum -22°F (-30°C)
Interfacing devices	HandReaders, wall switches, security consoles, access card readers, thermo-sensitive devices, smoke and fire alarms, telephone access controls, automatic time devices and computerized controls
Micro switch electrical rating for request-to-exit (RX) function and latchbolt monitor (LX)	3 amps, 125V AC; 2 amps, 30V DC

## L Series electrified functions

No Cylinder	L9090EL/EU Electrically locking/unlocking outside lever L9091EL/EU Electrically locking/unlocking both levers
Outside Cylinder	L9092EL/EU (Replaces L9080EL/EU) Electrically locking/unlocking outside lever L9093EL/EU Electrically locking/unlocking both levers
Inside & Outside Cylinder	L9094EL/EU Electrically locking/unlocking outside lever L9095EL/EU (Replaces L9082EL/EU) Electrically locking/unlocking both levers

Note: See pricebook for additional details.

## L Series electrified deadbolt functions

Outside Cylinder	L9492EL/EU Electrically locking/unlocking outsider lever L9493EL/EU Electrically locking/unlocking both levers
Inside & Outside Cylinder	L9494EL/EU Electrically locking/unlocking outsider lever L9495EL/EU Electrically locking/unlocking both levers

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## About Allegion

Allegion (NYSE: ALLE) is a global pioneer in safety and security, with leading brands like CISA®, Interflex®, LCN®, Schlage®, SimonsVoss® and Von Duprin®. Focusing on security around the door and adjacent areas, Allegion produces a range of solutions for homes, businesses, schools and other institutions. Allegion is a \$2 billion company, with products sold in almost 130 countries. For more, visit [www.allegion.com](http://www.allegion.com).



## Grade 1, mortise locks

# L Series

### Overview

The Schlage® L Series has long been the benchmark for Grade 1 mortise locks. Beyond strength and security – it offers flexibility to meet most needs. Fifty mechanical functions include ten that can be field configured from one universal lock case and ten electrified functions are regularly used as part of electronic access control systems. L Series locks have the ability to suite across electronic, tubular, exit trim, and multi-point locks to integrate seamlessly into any environment. The series features an array of security options including 180-degree visibility status indicators and support for multiple keyway families and cylinder types including Primus® XP high-security cylinders.



### Finishes



**605**  
Bright Brass



**606**  
Satin Brass



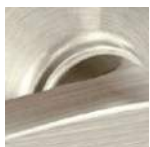
**609**  
Antique Brass



**612**<sup>1</sup>  
Satin Bronze



**613**<sup>1</sup>  
Oil Rubbed  
Bronze



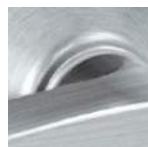
**619**  
Satin Nickel



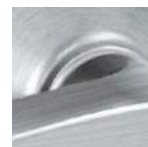
**622**  
Matte Black



**625**  
Bright Chrome



**626**  
Satin Chrome



**626AM**  
Satin Chrome,  
Antimicrobial



**629**<sup>2</sup>  
Bright Stainless



**630**<sup>2</sup>  
Satin Stainless



**630AM**<sup>2</sup>  
Satin Stainless,  
Antimicrobial



**643e**  
Aged Bronze

<sup>1</sup> Available on standard levers only, not available on Latitude, Longitude, Accent, Asti, or Merano

<sup>2</sup> Not available on Accent, Asti, or Merano



M Collection decorative lever styles<sup>1</sup>



**M51**  
851 - Knurled tactile warning



**M52**  
852 - Knurled tactile warning



**M53**



**M54**



**M55**



**M56**



**M57<sup>2</sup>**



**M61**  
■ Handed



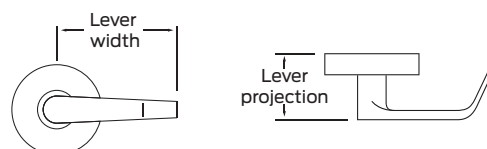
**M62<sup>2</sup>**  
■ Handed



**M63**  
■ Handed

**Dimensions**

Lever	Width	Projection
M51	4.5"	3.2"
M52	4.5"	3"
M53	4.35"	3.2"
M54	4.35"	2.75"
M55	4.3"	3"
M56	4.6"	3"
M57	4.5"	2.9"
M61	4.5"	3.2"
M62	4.5"	2.7"
M63	4.5"	3.2"



<sup>1</sup> M Collection not available in 612 and 613 finishes.

<sup>2</sup> Available in 629, 630, and 630AM only.





Grade 1, mortise locks

L Series

M Collection decorative lever styles<sup>1</sup>

**M81**  
881 - Knurled tactile warning



**M82**



**M83**



**M84**



**M85**  
■ Handed



**ME1**  
8ME1 - Milled tactile warning  
■ Handed



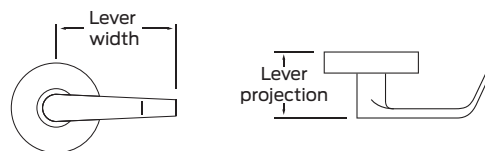
**ME2**  
8ME2 - Milled tactile warning  
■ Handed



**ME3**  
8ME3 - Milled tactile warning

## Dimensions

Lever	Width	Projection
M81	4.8"	2.9"
M82	4.8"	2.9"
M83	4.6"	2.9"
M84	5.1"	3"
M85	4.9"	3.3"
ME1	5.5"	3"
ME2	5.2"	2.8"
ME3	5.1"	3.2"



Return to door meets 1/2" requirement for all levers shown on this page.

ME1, ME2 and ME3 ergonomic levers designed with Gensler as product design consultant.



Grade 1, mortise locks

L Series

Standard lever and knob styles



01  
801 - Milled tactile warning



02  
802 - Knurled tactile warning



03  
803 - Knurled tactile warning



05  
805 - Milled tactile warning



06  
806 - Milled tactile warning



07  
807 - Milled tactile warning



12  
812 - Milled tactile warning  
■ Handed



17  
817 - Milled tactile warning



18  
818 - Milled tactile warning

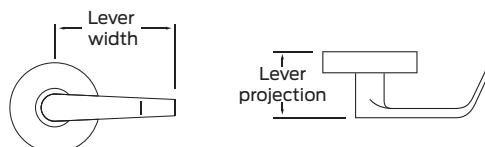


Accent (ACC)<sup>1</sup>  
■ Handed

Dimensions

Lever	Width	Projection
01	3.875"	2.688"
02	4.75"	2.813"
03	4.75"	2.813"
05	3.75"	2.875"
06	4.625"	2.5"
07	4.625"	2.875"
12	4.625"	3.063"
17	4.75"	3"
18	4.875"	2.688"
Accent (ACC)	4.125"	3.125"

Return to door meets 1/2" requirement for 03, 06 and 17 levers.



<sup>1</sup> Not available in 612, 613, 629, or 630 finishes.



Grade 1, mortise locks

L Series

## Standard lever and knob styles



**Asti (AST)<sup>1</sup>**  
 ■ Handed



**Latitude (LAT)<sup>2</sup>**



**Longitude (LON)<sup>2</sup>**



**Merano (MER)<sup>1</sup>**  
 ■ Handed



**Omega (OME)**



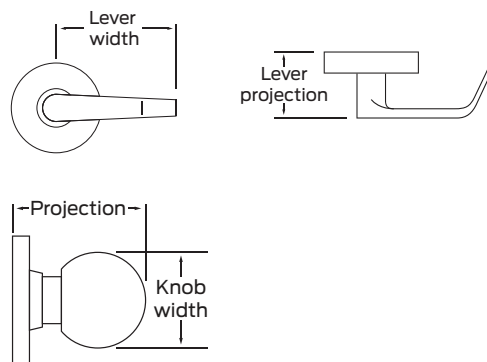
**41**



**42**

## Dimensions

Lever	Width	Projection
Asti (AST)	4"	2.625"
Latitude (LAT)	4.75"	2.563"
Longitude (LON)	4.875"	2.563"
Merano (MER)	4"	3.125"
Omega (OME)	5.063"	3.313"
41	2.211"	2.34"
42	2.132"	2.538"



Return to door meets 1/2" requirement for Longitude and Omega levers.

<sup>1</sup> Not available in 612, 613, 629, or 630 finishes.

<sup>2</sup> Not available in 612 or 613 finishes.



**Escutcheons**



**L full face**  
Specify by adding 'L' after lever design.



**L concealed**  
Specify by adding 'C' suffix to function and by adding 'L' after lever design.



**N full face**  
Specify by adding 'N' after lever design.

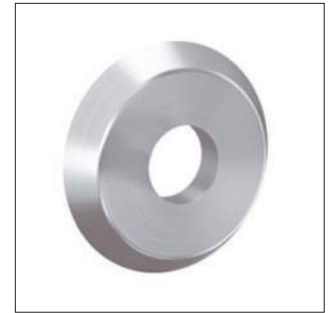
**Roses**



**A rose**  
Available for use on L Series knob and lever designs. Specify by adding 'A' after lever design  
**Finishes:** available in all L Series finishes.



**B rose**  
Available for use on L Series knob and lever designs. Specify by adding 'B' after lever design.  
**Finishes:** available in all L Series finishes.



**C rose**  
Available for use on L Series knob and lever designs. Specify by adding 'C' after lever design.  
**Finishes:** 605, 606, 609, 619, 622, 625, 626, 629, 630, 643e



**AVA rose**  
Available for use on ACC lever, other levers upon request.  
**Finishes:** 605, 606, 609, 619, 622, 625, 626, 643e

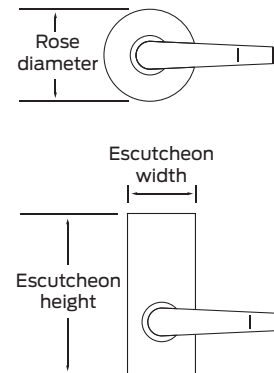


**MER rose**  
Available for use on MER lever, other levers upon request.  
**Finishes:** 605, 606, 609, 619, 622, 625, 626, 643e

**Dimensions**

Rose	Diameter
A	2.125"
B	2.5625"
C	2.625"
AVA	2.625"
MER	2.625"

Escutcheon	Width	Height
L full face	1.75"	8"
L concealed	1.75"	8"
N full face	2.5"	7.875"





**Thumbturns**



**Standard turn**  
09-509



**ADA turn**  
09-509 x L583-363  
Not available with L9463  
and L463

**Indicators**



**Cylinder**



**Thumbturn**



**Cointurn**



**Emergency key indicator**



**Cylinder**



**Thumbturn**



**Cointurn**



**Emergency key indicator**

	<b>Locked</b> <b>Unlocked</b>	<b>Occupied</b> <b>Unoccupied</b>	<b>Do Not Disturb</b>	<b>Do Not Disturb</b> 
Inside trim	L283-711	L283-712	L283-713	L283-714
Outside trim	L283-721	L283-722	L283-723	L283-724



Ligature resistant solutions



SL1<sup>1,2</sup>



SK1<sup>1,2</sup>



HSLR<sup>2,3</sup>

■ Handed

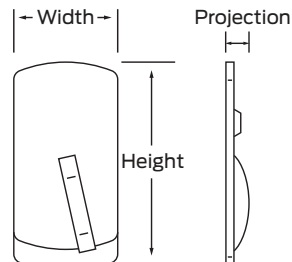
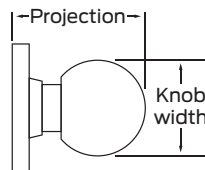
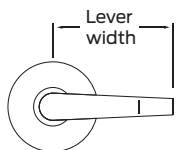
Specifications and certifications

	SL1	SK1	HSLR
Accepted by OHM	■	■	■
ADA compliant	■	-	■
Suitable for:			
High risk areas	-	■	■
Medium risk areas	■	■	■
Low risk areas	■	■	■

Caution: Cone shaped door knobs and thumbturns do not comply with ADA requirements for graspability.

Dimensions

	Width	Height	Projection
SL1	4.5"		3.13"
SK1	3.125"		2.3125"
HSLR	6"	13.17"	2.27"



<sup>1</sup> Only available in 630 and 630AM finishes.

<sup>2</sup> Not available with Vandlgard option.

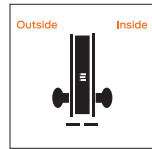
<sup>3</sup> Only available in 630 finish.



Vandlgard® protection available on functions noted with an “LV” option.

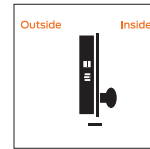
Vandlgard allows the outside lever to rotate freely down when locked to limit the ability of vandals to apply excessive force to the chassis helping to prevent damage to internal components.

**Non-keyed functions**



**Schlage L9010**  
**ANSI F01**  
**Passage latch**

- Latchbolt retracted by lever/knob from either side at all times
- Inside lever always free for immediate egress

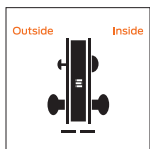


**Schlage L9025**  
**ANSI F31**  
**Exit lock**

- No outside trim
- Inside lever always free for immediate egress



Optional HSLR trim available

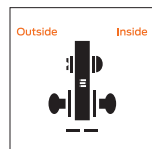


**Schlage L9040**  
**LV9040**  
**ANSI F22**  
**Bath/bedroom privacy lock**

- Latchbolt retracted by lever/knob from either side unless outside lever is locked by inside thumbturn
- Actuating inside lever or closing door unlocks outside lever
- To unlock from outside remove emergency button, insert emergency thumbturn in access hole and rotate
- Inside knob/lever is always free for immediate egress



Optional 180 degree messaging indicator available



**Schlage L9044**  
**LV9044**  
**ANSI -**  
**Privacy with coin turn outside**

- Latchbolt retracted by lever/knob from either side unless outside lever is locked by inside thumbturn or outside coin turn
- Actuating inside lever, closing door, or rotating outside coin turn unlocks outside lever
- Available in rose trim only



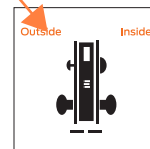
Coin turn for lock with rose trim



Optional 180 degree messaging indicator available



Optional HSLR trim available



**Schlage L9440**  
**LV9440**  
**ANSI F19**  
**Privacy with deadbolt**

- Latchbolt retracted by lever/knob from either side
- Deadbolt actuated by inside thumbturn
- Throwing deadbolt locks outside knob/lever
- Inside lever retracts both deadbolt and latchbolt and unlocks outside lever
- To unlock from outside remove emergency button, insert emergency thumbturn in access hole and rotate
- Inside lever always free for immediate egress



Optional 180 degree messaging indicator available

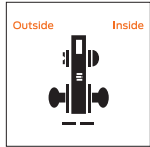




Grade 1, mortise locks

L Series

## Non-keyed functions



Schlage L9444  
LV9444

ANSI -

Privacy with deadbolt and  
coin turn outside

- Latchbolt retracted by knob/lever from either side
- Deadbolt actuated by inside thumbturn or outside coin turn
- Throwing deadbolt locks outside knob/lever
- Inside lever retracts both deadbolt and latchbolt and unlocks outside lever
- Rotating coin turn retracts deadbolt and unlocks outside lever
- Inside lever always free for immediate egress
- Available with rose trim only



Coin turn for lock with rose trim



Optional 180 degree messaging  
indicator available



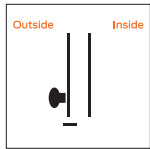
Optional HSLR trim available





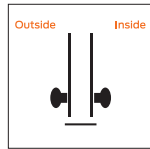


### Non-keyed dummy functions



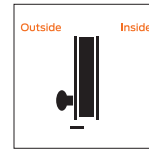
**Schlage L0170**  
ANSI -  
Half dummy trim

- Fixed lever/knob on one side



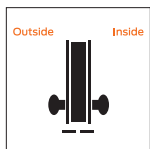
**Schlage L0172**  
ANSI -  
Full dummy trim

- Fixed lever/knob on both sides



**Schlage L9175**  
ANSI -  
Half dummy trim with lock case

- Fixed lever/knob on one side
- Includes lock case and blank armor plate



**Schlage L9176**  
ANSI -  
Full dummy trim with lock case

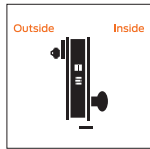
- Fixed lever/knob on both sides
- Includes lock case and blank armor plate

In a double-door application where the dummy will be used as the strike order 10-091 armored front strike separately.



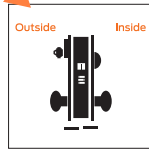


## Single cylinder non-deadbolt functions



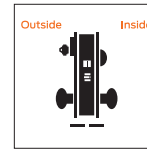
**Schlage L9026**  
ANSI -  
**Exit lock with cylinder**

- No outside trim
- Outside cylinder retracts latchbolt
- Inside lever always free for immediate egress
- Auxiliary latch deadlocks latchbolt when door is locked



**Schlage L9050**  
LV9050  
ANSI F04  
**Office and inner entry lock**

- Latchbolt retracted by knob/lever from either side unless outside is made inoperative by key outside or by turning inside thumbturn
- When outside is locked, latchbolt is retracted by key outside or by knob/lever inside
- Outside knob/lever remains locked until thumbturn is returned to vertical or unlocked by key
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside knob/lever is always free for immediate egress



**Schlage L9056**  
LV9056  
ANSI -  
**L9050 with automatic unlocking**

- Latchbolt retracted by knob/lever from either side unless outside is made inoperative by key outside or by rotating inside thumbturn
- Outside knob/lever unlocked by key outside, thumbturn or closing door
- Rotating inside knob/lever simultaneously retracts latchbolt and unlocks outside knob/lever
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside knob/lever is always free for immediate egress



Optional 180 degree messaging indicator available



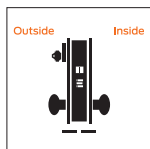
Optional HSLR trim available



Optional 180 degree messaging indicator available



Optional HSLR trim available



**Schlage L9070**  
LV9070  
ANSI F05  
**Classroom lock**

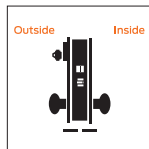
- Latchbolt retracted by lever/knob from either side unless outside lever is locked by key
- Unlocked from outside by key
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside lever always free for immediate egress



Optional 180 degree messaging indicator available

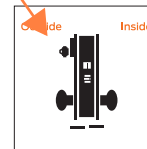


Optional HSLR trim available



**Schlage L9076**  
LV9076  
ANSI F06  
**Classroom holdback lock**

- Latchbolt retracted by lever/knob from either side unless outside lever is locked by key
- When locked, latchbolt retracted by key or inside lever
- Auxiliary latch deadlocks latchbolt when door is locked
- Holdback feature activated by turning inside lever/knob and rotating key 360°
- Inside lever always free for immediate egress



**Schlage L9080**  
LV9080  
ANSI F07  
**Storeroom lock**

- Latchbolt retracted by lever/knob inside or key outside
- Outside lever/knob is always inoperable
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside lever always free for immediate egress

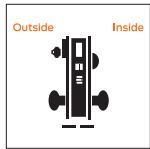


Optional HSLR trim available





Single cylinder deadbolt functions

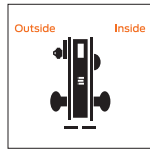


**Schlage L9453**  
**LV9453**  
**ANSI F20**  
**Entrance lock**

- Latchbolt retracted by lever/knob from either side unless outside locked by 20° thumbturn rotation
- Deadbolt actuation through 90° thumbturn rotation
- When locked, outside key or inside lever/knob retracts both deadbolt and latchbolt
- Outside lever/knob locked until thumbturn is restored to vertical position
- Throwing deadbolt locks outside lever/knob
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside lever always free for immediate egress



Optional HSLR trim available

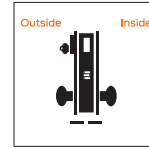


**Schlage L9456**  
**LV9456**  
**ANSI F13**  
**Corridor lock**

- Latchbolt retracted by lever/knob from either side
- Deadbolt actuation by key or thumbturn rotation
- Throwing deadbolt locks outside lever/knob
- Turning inside knob/lever retracts both deadbolt and latchbolt and unlocks outside lever/knob
- Inside lever always free for immediate egress



Optional HSLR trim available

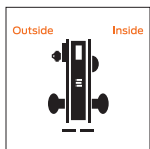


**Schlage L9465**  
**ANSI -**  
**Closet/storeroom lock**

- Latchbolt retracted by lever/knob from either side
- Deadbolt actuation by key



Optional HSLR trim available



**Schlage L9473**  
**ANSI F21**  
**Dormitory/bedroom lock**

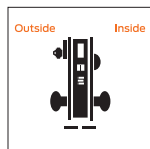
- Latchbolt retracted by lever/knob from either side
- Deadbolt actuation by outside key or inside thumbturn



Optional 180 degree messaging indicator available



Optional HSLR trim available



**Schlage L9480**  
**LV9480**  
**ANSI -**  
**Storeroom lock with deadbolt**

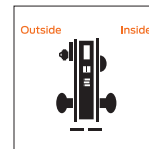
- Latchbolt retracted by outside key or inside knob/lever
- Outside knob/lever always fixed
- Deadbolt actuation by outside key or inside thumbturn
- Inside knob/lever actuation retracts both deadbolt and latchbolt
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside lever always free for immediate egress



Optional 180 degree messaging indicator available



Optional HSLR trim available



**Schlage L9485**  
**LV9485**  
**ANSI -**  
**Faculty/hotel/restroom lock**

- Latchbolt retracted by outside key or inside knob/lever
- Outside knob/lever always fixed
- Deadbolt actuation by thumbturn
- All keys (except emergency) inoperative when deadbolt is thrown
- Inside knob/lever retracts both deadbolt and latchbolt
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside lever always free for immediate egress



Optional 180 degree messaging indicator available

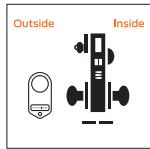


Optional HSLR trim available





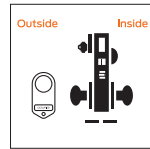
## Single cylinder deadbolt functions



Schlage L9486  
LV9486  
ANSI F15

L/LV9485 with 09-611  
"DO NOT DISTURB"  
indicator for rose trim

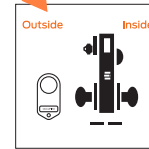
- Latchbolt retracted by outside key or inside knob/lever
- Outside knob/lever always fixed
- Deadbolt actuation by thumbturn
- When deadbolt is thrown "DO NOT DISTURB" message is displayed and all keys (except emergency) become inoperative
- Inside knob/lever retracts both deadbolt and latchbolt
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside lever always free for immediate egress



Schlage L9486xL583-375  
LV9486xL583-375  
ANSI -

L/LV9485 with "OCCUPIED"  
indicator for rose trim

- Latchbolt retracted by outside key or inside knob/lever
- Outside knob/lever always fixed
- Deadbolt actuation by thumbturn
- When deadbolt is thrown "OCCUPIED" message is displayed and all keys (except emergency) become inoperative
- Inside knob/lever retracts both deadbolt and latchbolt
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside lever always free for immediate egress



Schlage L9496  
ANSI -

Privacy with 09-611  
"OCCUPIED" indicator for  
rose trim

- Latchbolt retracted by knob/lever from either side
- Deadbolt actuation by outside key or inside thumbturn
- Thrown deadbolt displays "OCCUPIED" message and locks outside lever
- Inside knob/lever retracts both deadbolt and latchbolt and unlocks outside lever
- Inside lever always free for immediate egress



Adds hotel occupancy indicator (09-611) for lock with A or B roses on sectional trim. Message: "DO NOT DISTURB".



Adds hotel occupancy indicator (09-611) for lock with A or B roses on sectional trim. Message: "OCCUPIED".

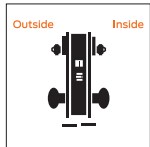


Adds hotel occupancy indicator (09-611) for lock with A or B roses on sectional trim. Message: "OCCUPIED".





Double cylinder non-deadbolt functions

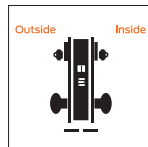


**Schlage L9060**  
**LV9060**  
**ANSI F09**  
**Apartment entrance lock**

- Latchbolt retracted by knob/lever from either side unless outside is locked by key from inside
- When locked, latchbolt retracted by key outside or knob/lever inside
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside knob/lever is always free for immediate egress



Optional 180 degree messaging indicator available



**Schlage L9071**  
**LV9071**  
**ANSI F32**  
**Classroom security lock**

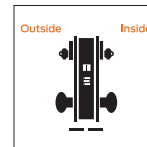
- Latchbolt retracted by knob/lever from either side unless outside is locked by key from either side
- When locked, latchbolt retracted by outside key or inside knob/lever
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside knob/lever always free for immediate egress



Optional 180 degree messaging indicator available



Optional HSLR trim available

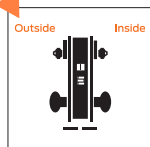


**Schlage L9077**  
**LV9077**  
**ANSI -**  
**Classroom security holdback lock**

- Latchbolt retracted by knob/lever from either side unless outside is locked by key from either side
- When locked, latchbolt retracted by key outside or knob/lever inside
- Auxiliary latch deadlocks latchbolt when door is locked
- Rotate inside lever/knob and turn key 360° to enable holdback feature
- Inside knob/lever always free for immediate egress



Optional 180 degree messaging indicator available



**Schlage L9082**  
**LV9082**  
**ANSI F30**  
**Institution lock**

- Latchbolt retracted by key from either side
- Knob/lever on both sides always inoperative
- Auxiliary latch deadlocks latchbolt when door is locked

Caution: Double cylinder locks on any door, in any structure requiring use of a key to achieve egress can create a life safety hazard in times of emergency and their use is not recommended. Installation should be in accordance with existing codes only.



Optional 180 degree messaging indicator available

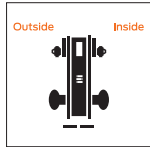


Optional HSLR trim available





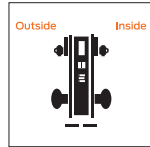
## Double cylinder deadbolt functions



**Schlage L9457**  
**LV9457**  
**ANSI F33**

**Classroom security lock with deadbolt**

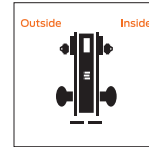
- Latchbolt retracted by lever/knob from either side
- Deadbolt actuated by either key
- Throwing deadbolt locks outside lever/knob
- Actuating inside lever/knob retracts both deadbolt and latchbolt and unlocks outside lever
- Inside lever always free for immediate egress



**Schlage L9458**  
**LV9458**  
**ANSI F34**

**Classroom security lock w/deadbolt and auxiliary latch**

- Latchbolt retracted by knob/lever from either side
- Deadbolt actuated by either key
- When door is locked outside lever inoperative
- Inside lever retracts deadbolt and latchbolt and unlocks outside lever
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside lever always free for immediate egress



**Schlage L9466**  
**ANSI F14**

**Store/utility room lock with deadbolt**

- Latchbolt retracted by knob/lever from either side
- Deadbolt thrown or retracted by key from either side

Caution: Double cylinder locks on any door, in any structure requiring use of a key to achieve egress can create a life safety hazard in times of emergency and their use is not recommended. Installation should be in accordance with existing codes only.



Optional HSLR trim available



Optional 180 degree messaging indicator available

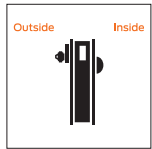


Optional HSLR trim available





Mortise deadlock functions

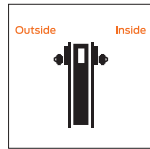


**Schlage L9460**  
ANSI F17  
**Cylinder x thumbturn lock**

- Deadbolt actuated by key or thumbturn



Optional 180 degree messaging indicator available



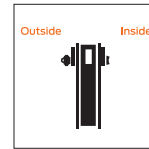
**Schlage L9462**  
ANSI F16  
**Double cylinder lock**

- Deadbolt actuated by either key

Caution: Double cylinder locks on any door, in any structure, requiring the use of a key to achieve egress can create a life safety hazard in times of emergency and their use is not recommended. Installation should be in accordance with existing codes only.



Optional 180 degree messaging indicator available

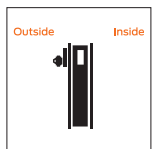


**Schlage L9463**  
ANSI F29  
**Classroom lock**

- Deadbolt actuated by key
- Thumbturn retracts deadbolt but cannot extend it



Optional 180 degree messaging indicator available



**Schlage L9464**  
ANSI F18  
**Cylinder lock**

- Deadbolt actuated by key
- No trim opposite side

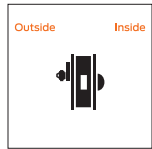


Optional 180 degree messaging indicator available





Small mortise deadlock functions

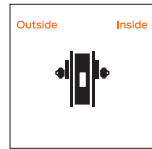


**Schlage L460**  
ANSI E06071  
**Cylinder x thumbturn lock**

- Deadbolt actuated by key or thumbturn



Optional 180 degree messaging indicator available



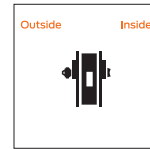
**Schlage L462**  
ANSI E06061  
**Double cylinder lock**

- Deadbolt actuated by either key

Caution: Double cylinder locks on any door, in any structure, requiring use of a key to achieve egress can create a life safety hazard in times of emergency and their use is not recommended. Installation should be in accordance with existing codes only.



Optional 180 degree messaging indicator available

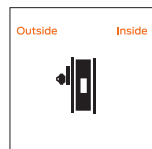


**Schlage L463**  
ANSI E06091  
**Classroom lock**

- Deadbolt actuated by key
- Thumbturn retracts deadbolt but cannot extend it



Optional 180 degree messaging indicator available

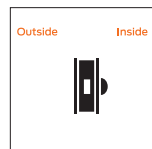


**Schlage L464**  
ANSI E06081  
**Cylinder lock**

- Deadbolt actuated by key
- No trim opposite side



Optional 180 degree messaging indicator available

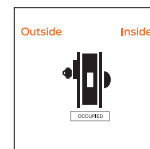


**Schlage L480**  
ANSI -  
**Door bolt**

- Deadbolt actuated by thumbturn
- No trim opposite side



Optional 180 degree messaging indicator available



**Schlage L496**  
ANSI -  
**Deadbolt with "OCCUPIED" indicator**

- Deadbolt actuated by key or thumbturn
- When deadbolt is thrown "OCCUPIED" message is displayed



Optional 180 degree messaging indicator available



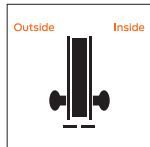




Grade 1, mortise locks

L Series

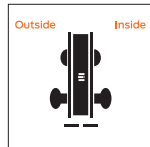
## Special functions



**Schlage L9110 x XL11-741**  
ANSI -

**Double dummy with active trim**

- Knob/lever both sides active
- Lock case and armor front included
- Can receive deadbolt with XL11-743 armor front

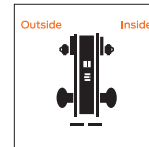


**Schlage L0940 x XL11-446**  
LV9040 x XL11-446

ANSI -

**Privacy with turn both sides**

- Latchbolt retracted by either lever
- Rotating either thumbturn locks outside lever
- Actuating inside lever, closing door, or rotating either thumbturn unlocks outside lever



**Schlage L9066 x XL11-897**  
ANSI -

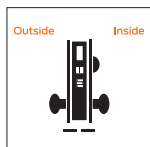
**Storeroom lock**

- Either key retracts latchbolt
- Either key locks or unlocks both levers

Caution: Double cylinder locks on any door, in any structure requiring use of a key to achieve egress can create a life safety hazard in times of emergency and their use is not recommended. Installation should be in accordance with existing codes only.



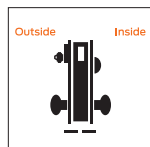
Optional 180 degree messaging indicator available



**Schlage L9412 x XL11-907**  
ANSI -

**Exit lock with deadbolt**

- Latchbolt retracted by inside lever
- Outside lever always fixed
- Thumbturn actuates deadbolt
- Inside lever retracts deadbolt and latchbolt
- Auxiliary latch deadlocks latchbolt when door is locked



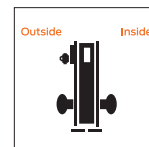
**Schlage L9460 x XL11-635**  
ANSI -

**L9460 with fixed dummy trim**

- Knob/lever both sides fixed
- Deadbolt thrown or retracted by key outside or thumbturn inside
- Specify per XL11-635



Optional 180 degree messaging indicator available



**Schlage L9460, L9462, L9464 x XL11-886**  
ANSI -

**Deadbolt with retraction by inside lever or knob**

L9460 x XL11-886

- Deadbolt actuation by key or thumbturn
- Outside lever always fixed
- Inside lever active when deadbolt is thrown
- Inside lever retracts deadbolt

L9462 x XL11-886

- Same as L9460 x XL11-886 except deadbolt actuated by key from either side

L9464 x XL11-886

- Same as L9460 x XL11-886 except deadbolt actuated by key from one side

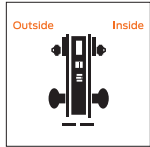


Optional 180 degree messaging indicator available





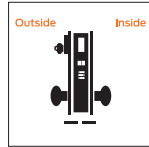
## Special functions



Schlage L9482 x XL11-543  
LV9482 x XL11-543  
ANSI -  
**Institutional lock with  
deadbolt**

- Latchbolt retracted by either key
- Both levers always inoperative
- Deadbolt actuated by either key
- Auxiliary latch deadlocks latchbolt when door is locked

Caution: Double cylinder locks on any door, in any structure requiring use of a key to achieve egress can create a life safety hazard in times of emergency and their use is not recommended. Installation should be in accordance with existing codes only.



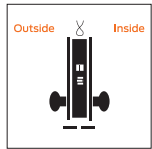
Schlage L9485 x XL11-557  
ANSI -  
**Prison function lock**

- Latchbolt retracted by outside key or inside knob/lever
- Outside knob/lever always free spinning
- Deadbolt actuation by guard key
- Inside knob/lever fixed when deadbolt is thrown
- Prisoner key only retracts latchbolt
- Tamper resistant Torx screws standard





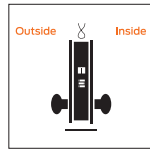
## Electrified locks functions



Schlage L9090EL  
L9090EU  
ANSI F13

Electrically locking/  
unlocking outside lever  
(no cylinder)

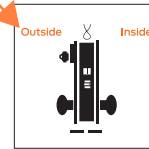
- Outside lever/knob continuously locked (EL) or unlocked (EU) by 12V or 24V DC
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside lever/knob always free for immediate egress



Schlage L9091EL  
L9091EU  
ANSI -

Electrically locking/  
unlocking both levers (no  
cylinder)

- Both levers/knobs continuously locked (EL) or unlocked (EU) by 12V or 24V DC
- Auxiliary latch deadlocks latchbolt when door is locked



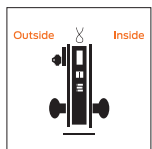
Schlage L9092EL  
L9092EU  
ANSI -

Electrically locking/  
unlocking outside lever  
(single cylinder)

- Outside lever/knob continuously locked (EL) or unlocked (EU) by 12V or 24V DC
- Latchbolt retracted by lever/knob inside or key outside
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside lever/knob always free for immediate egress
- EL: Switch or power failure allows outside lever/knob to retract latchbolt
- EU: Switch or power failure locks (EU) outside lever/knob



Optional HSLR trim available



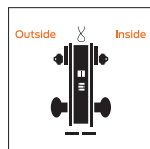
Schlage L9093EL  
L9093EU  
ANSI -

Electrically locking/  
unlocking both levers  
(outside cylinder)

- Both levers/knobs continuously locked (EL) or unlocked (EU) by 12V or 24V DC
- Latchbolt retracted by key outside
- Auxiliary latch deadlocks latchbolt when door is locked



Optional HSLR trim available



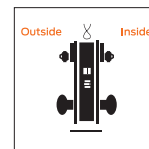
Schlage L9094EL  
L9094EU  
ANSI -

Electrically locking/  
unlocking outside lever  
(double cylinder)

- Outside lever/knob continuously locked (EL) or unlocked (EU) by 12V or 24V DC
- Latchbolt retracted by either key or by inside lever/knob
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside lever/knob always free for immediate egress



Optional HSLR trim available



Schlage L9095EL  
L9095EU  
ANSI -

Electrically locked or  
electrically unlocked both  
levers (double cylinder)

- Both levers/knobs continuously locked (EL) or unlocked (EU) by 12V or 24V DC
- Latchbolt retracted by either key
- Auxiliary latch deadlocks latchbolt when door is locked
- EL: Switch or power failure unlocks both levers/knobs and allows knob/lever to retract latchbolt
- EU: Switch or power failure locks both levers/knobs

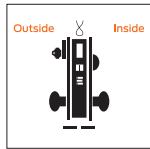


Optional HSLR trim available





## Electrified locks functions



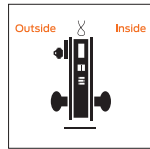
**Schlage L9492EL  
L9492EU**  
ANSI -

**Electrically locking/  
unlocking outside lever  
(outside cylinder, inside  
thumbturn with deadbolt)**

- Outside lever continuously locked (EL) or unlocked (EU) 12V or 24V DC
- Deadbolt actuation by key or thumbturn
- Inside lever retracts both deadbolt and latchbolt
- For EU outside lever retracts deadbolt and latchbolt
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside lever always free for immediate egress



Optional HSLR trim available



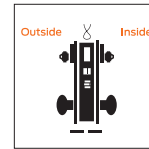
**Schlage L9493EL  
L9493EU**  
ANSI -

**Electrically locking/  
unlocking both levers  
(outside cylinder, inside  
thumbturn with deadbolt)**

- Deadbolt actuation by key or thumbturn
- Inside lever retracts both deadbolt and latchbolt
- For EU both levers retract deadbolt and latchbolt
- Auxiliary latch deadlocks latchbolt when door is locked



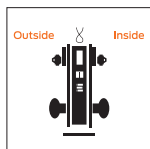
Optional HSLR trim available



**Schlage L9494EL  
L9494EU**  
ANSI -

**Electrically locking/  
unlocking outside lever  
(double cylinder with  
deadbolt)**

- Outside lever continuously locked (EL) or unlocked (EU) 12V or 24V DC
- Deadbolt actuation by either key
- Inside lever retracts both deadbolt and latchbolt
- For EU outside lever retracts deadbolt and latchbolt
- Auxiliary latch deadlocks latchbolt when door is locked
- Inside lever always free for immediate egress



**Schlage L9495EL  
L9495EU**  
ANSI -

**Electrically locking/  
unlocking both levers  
(double cylinder with  
deadbolt)**

- Both levers continuously locked (EL) or unlocked (EU) 12V or 24V DC
- Deadbolt actuation by either key
- When unlocked both levers retract deadbolt and open door
- Auxiliary latch deadlocks latchbolt when door is locked

### Available electrified options include:

- RX** Request to Exit
- LX** Latch bolt monitor
- DPS** Door Position Switch
- DM** Deadbolt monitor (DM)





## Cylinders

### Conventional mortise cylinder

<b>P</b>	6-pin Conventional (standard) with Schlage logo
<b>Z</b>	SL 7-pin Conventional (A2 pinning) with Schlage logo
<b>L</b>	Less full face cylinder
<b>C</b>	Concealed mortise cylinder
<b>W</b>	Less concealed mortise cylinder

### Full size interchangeable core (FSIC) mortise cylinder

<b>R</b>	6-pin FSIC with Schlage logo
<b>M</b>	SL 7-pin FSIC (A2 pinning) with Schlage logo
<b>J</b>	Less FSIC
<b>F</b>	6-pin FSIC less Schlage logo
<b>T</b>	Refundable FSIC construction core

### Small format interchangeable core (SFIC) mortise cylinder

<b>G</b>	7-pin SFIC (A2 pinning) with Schlage logo
<b>B</b>	Less core
<b>BDC</b>	Disposable SFIC construction core
<b>H</b>	Refundable SFIC construction core



## Specifications

### Chassis

Case material	CRS with zinc dichromate plating
Case size	L9000 Series: 4 <sup>7</sup> / <sub>16</sub> " x 6 <sup>1</sup> / <sub>16</sub> " x 1" (113 mm x 154 mm x 25 mm) L400 Series: 4 <sup>7</sup> / <sub>16</sub> " x 3 <sup>5</sup> / <sub>8</sub> " x 1" (113 mm x 92 mm x 25 mm)
Spacing	Knob or lever to cylinder: 3 <sup>7</sup> / <sub>8</sub> " (98 mm); Knob or lever to thumbturn hub: 2 <sup>11</sup> / <sub>16</sub> " (68 mm)
Door thickness	Standard: 1 <sup>3</sup> / <sub>4</sub> " (44 mm) Optional: 1 <sup>3</sup> / <sub>8</sub> " (35 mm) to 2 <sup>1</sup> / <sub>2</sub> " (64 mm) Over 2 <sup>1</sup> / <sub>2</sub> " (64 mm) door ranges vary by function. Specify door thickness if other than 1 <sup>3</sup> / <sub>4</sub> " and position in door EE, EI, EO, ED

### Trim

Handing	L9000 Series: Field-reversible without disassembly L400 Series: Non-handed
Lever/knob	Lever designs: forged brass or bronze and cast stainless steel Knob designs: heavy-duty wrought brass, bronze or stainless steel
Rose/ escutcheon	L full face and concealed: Cold-forged brass, bronze and stainless steel N full face: Heavy wrought reinforced brass, bronze and stainless steel Roses: A, B, C: wrought brass or bronze and stainless steel; AVA and MER: forged brass
Combinations	Available with knob both sides, lever both sides, or knob/lever combinations. Roses cannot be combined with escutcheons.

### Latch

Backset	2 <sup>3</sup> / <sub>4</sub> " (70 mm) only
Armor	L9000 Series Standard: 1 <sup>1</sup> / <sub>4</sub> " x 8" x <sup>7</sup> / <sub>32</sub> " (32 mm x 203 mm x 6 mm) Optional: 1 <sup>1</sup> / <sub>16</sub> " x 8" x <sup>7</sup> / <sub>32</sub> " (27 mm x 203 mm x 6 mm) L400 Series: Standard: 1 <sup>1</sup> / <sub>4</sub> " x 5 <sup>9</sup> / <sub>16</sub> " x <sup>7</sup> / <sub>32</sub> " (32 mm x 141 mm x 6 mm)
Latch	<sup>3</sup> / <sub>4</sub> " (19 mm) throw stainless steel latch with anti-friction tongue
Deadbolt	1" (25 mm) throw stainless steel deadbolt
Strike	L9000 Series Standard: ANSI curved lip strike 1 <sup>1</sup> / <sub>4</sub> " x 4 <sup>7</sup> / <sub>8</sub> " (32 mm x 124 mm) x 1 <sup>3</sup> / <sub>16</sub> " (30 mm) lip to center with dust box Optional: Extended lip strike options ( <sup>7</sup> / <sub>8</sub> ", 1", 1 <sup>1</sup> / <sub>2</sub> ", 1 <sup>3</sup> / <sub>4</sub> ", 2") L400 Series Standard: 1 <sup>1</sup> / <sub>8</sub> " x 3 <sup>1</sup> / <sub>2</sub> " (29 mm x 89 mm) with dust box Optional: 1 <sup>1</sup> / <sub>4</sub> " x 4 <sup>7</sup> / <sub>8</sub> " (32 mm x 124 mm) with dust box



## Specifications

<b>Keying</b>	
Cylinder format	6-pin Conventional mortise cylinder (standard); also available in concealed mortise cylinder, FSIC, SFIC and 7-pin SL cylinder formats plus less cylinder options.
Keyway	Patented Everest 29 S123 (standard); also available in open, restricted, and Primus XP security levels with available master keying and construction keying.
<b>Wired electrified</b>	
Input voltage	12V or 24V DC for L909X
Operating mode	Fail Safe or Fail Secure via switch on chassis
Current draw	0.23 amps maximum; 0.01 amps holding
Request to Exit	Rating: 3A @ 125V AC/2A @ 30V DC. Available on all L909X and L949X electrified functions. Also available option for the following mechanical functions: L9010/50/56/70/71/80 and L9453/56/58/65/66/80/85.
Latch bolt monitor	Available on all L909x and L949x electrified and L9010/25/26/50/56/70/71/80/82 and L9453/56/65/66/80/85 mechanical functions.
Door position sensor	Internal available on L909x electrified and L9010/80/82 mechanical functions; external available on all functions.
Deadbolt monitor	Available on L949x electrified and L9453/56/57/58/80/85/86/96 mechanical functions
<b>Warranty</b>	
	3 year limited mechanical and 1 year limited electromechanical
<b>Certifications</b>	
ANSI/BHMA	L/LV9000: ANSI/BHMA A156.13-2017 Series 1000, Grade 1 operation and security; with FSIC Grade 2; with SFIC Grade 3 L400: ANSI/BHMA A156.36, Grade 1
ICC	Complies with ICC A117.1 Accessible and Usable Buildings and Facilities
UL/cUL	Mechanical: UL 10C and CAN/ULC-S104 3 hour fire listed; all locks listed for A label single doors, 4' x 10' and pairs 8' x 10' Electrified: UL/ULC listed for single-point locking applications; UL listed for 3-hour fire door (except L9076 and L9077)
CA Fire Code	All levers with a return to door of 1/2" (64 mm) or less comply
FL Building Code	Miami-Dade NOA's and Florida Building Commission listings
Federal	BAA compliant, all functions

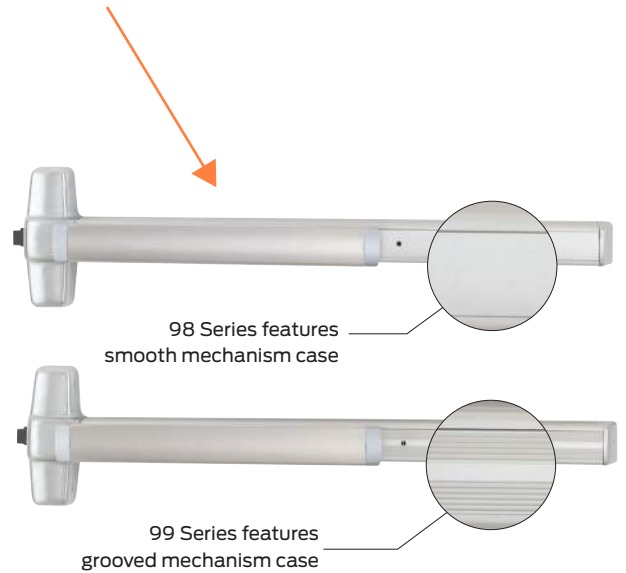
# VON DUPRIN®

## Exit device

# 98/99 Series

### Overview

The 98/99 Series devices are heavy-duty push pads. The 98 Series has a smooth mechanism case, while the 99 Series has a grooved mechanism case. The 98/99 Series has been certified to the highest industry standards and are used in schools, hospitals and government buildings.



### Device types



Rim device



75 Mortise lock device



27 Surface mounted vertical rod device<sup>1</sup>



47 Concealed vertical rod device, 5/16" throw<sup>1</sup>

48 Concealed vertical rod device, 5/8" top, 1 1/2" bottom throw



47WDC Concealed vertical rod wood door device<sup>1</sup>



49 Concealed vertical cable device<sup>2</sup>



50WDC Concealed vertical cable wood door device



57 Three-point latch device

<sup>1</sup> Also available less bottom rod (LBR)

<sup>2</sup> Also available less bottom latch (LBL)



# VON DUPRIN®

Exit device  
98/99 Series

## Finishes



**605**  
Bright Brass



**606**  
Satin Brass



**612**  
Satin Bronze



**619**  
Satin Nickel



**622**  
Matte Black



**625**  
Bright Chrome



**626**  
Satin Chrome



**626AM**  
Satin Chrome,  
Antimicrobial



**628**  
Aluminum, Clear  
Anodized



**630**  
Satin Stainless



**630AM**  
Satin Stainless,  
Antimicrobial



**643e**  
Aged Bronze



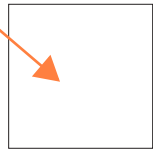
**693**  
Black



**710**  
Dark Brown,  
Anodized

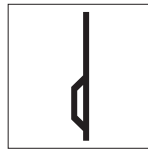
Due to the many variations in monitors and printers, color samples may appear different than the physical product. Contact your local sales representative for a physical color sample.

## Trim functions



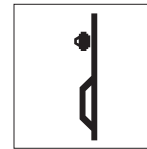
### EO No outside trim

- Exit only



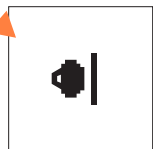
### DT Dummy trim

- Pull when dogged (not recommended for fire device)



### NL Night latch

- Key retracts latchbolt
- Rim and 1 1/4" mortise cylinder



### NLOP Night latch

- Key retracts latchbolt, pull required



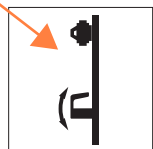
### TP Thumbpiece

- Key locks and unlocks
- Rim and 1 1/4" mortise cylinder



### TPBE Thumbpiece, blank escutcheon

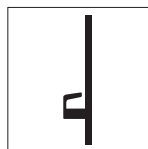
- Blank escutcheon always operable (no cylinder, use with DT trim)



### L Lever

### K Knob

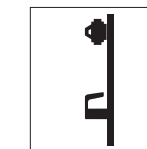
- Key locks and unlocks
- Rim and 1 1/4" mortise cylinder
- Handed, reversible lever
- Electrified lever operation available



### LDT Lever, dummy trim

### KDT Knob, dummy trim

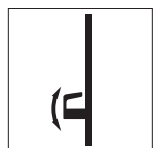
- Pull when dogged



### LNL Lever, night latch

### KNL Knob, night latch

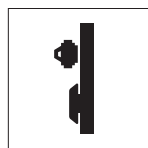
- Key retracts latchbolt
- Rim and 1 1/4" mortise cylinder
- Handed, reversible lever



### LBE<sup>1</sup> Lever, blank escutcheon

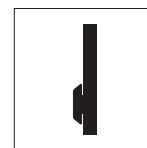
### KBE Knob, blank escutcheon

- Always operable (no cylinder)



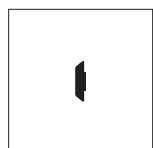
### TL Turn lever

- Key locks and unlocks (use with DT trim)
- 1 1/4" mortise cylinder

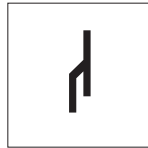


### TLBE Turn lever, blank escutcheon

- Blank escutcheon always operable (no cylinder, use with DT trim)



### TLOP Turn lever, optional pull



### HL Hospital latch

- Key locks and unlocks
- 1 1/4" mortise cylinder

# VON DUPRIN®

Exit device

98/99 Series

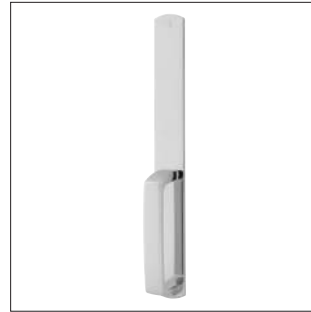
## Trim styles



990



996



696



697

3/4" (19mm) diameter pull



392-7



HL



374



VR910



VR914

## Dimensions

Trim style	Width	Height	Thickness	Projection
990	3"	14 <sup>3</sup> / <sub>16</sub> "	<sup>3</sup> / <sub>32</sub> "	2"
996 Knob	2 <sup>3</sup> / <sub>4</sub> "	10 <sup>3</sup> / <sub>4</sub> "	<sup>27</sup> / <sub>32</sub> "	3 <sup>1</sup> / <sub>4</sub> "
996 Lever	2 <sup>3</sup> / <sub>4</sub> "	10 <sup>3</sup> / <sub>4</sub> "	<sup>27</sup> / <sub>32</sub> "	2 <sup>7</sup> / <sub>8</sub> "
696	1 <sup>5</sup> / <sub>8</sub> "	13 <sup>1</sup> / <sub>2</sub> "	<sup>3</sup> / <sub>16</sub> "	2 <sup>1</sup> / <sub>8</sub> "
697	1 <sup>5</sup> / <sub>8</sub> "	13 <sup>1</sup> / <sub>2</sub> "	<sup>3</sup> / <sub>16</sub> "	3"
392-7	<sup>3</sup> / <sub>4</sub> " inch round stainless steel with 7" center to center that matches the 98/99 center case. 3 <sup>1</sup> / <sub>2</sub> " offset with 1 <sup>1</sup> / <sub>2</sub> " clearance.			
HL	2 <sup>9</sup> / <sub>16</sub> "	7 <sup>7</sup> / <sub>8</sub> "	-	2 <sup>5</sup> / <sub>8</sub> "
374	2 <sup>3</sup> / <sub>4</sub> "	10 <sup>3</sup> / <sub>4</sub> "	<sup>27</sup> / <sub>32</sub> "	
VR910/914 with RIM/verticals	5 <sup>1</sup> / <sub>2</sub> "	11"	-	
VR910/914 with mortise	7 <sup>1</sup> / <sub>4</sub> "	11"	-	

## Lever styles

### Decorative levers



**M51**  
■ Knurling available



**M52**  
■ Knurling available



**M53**



**M54**



**M55**



**M56**



**M57<sup>1</sup>**



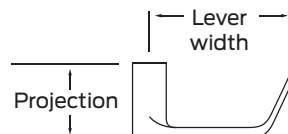
**M61**  
■ Handed



**M62<sup>1</sup>**  
■ Handed

### Dimensions

Lever	Width	Projection
M51	4.5"	2.5"
M52	4.5"	2.4"
M53	4.4"	2.4"
M54	4.4"	2.3"
M55	4.4"	2.7"
M56	4.5"	2.3"
M57	4.5"	2.7"
M61	4.5"	2.7"
M62	4.6"	2.4"



<sup>1</sup> Available in stainless steel substrate only

## Lever styles

### Decorative levers



**M63**  
▪ Handed



**M81**  
▪ Knurling available



**M82**



**M83**



**M84**



**M85**  
▪ Handed



**ME1**  
▪ Handed



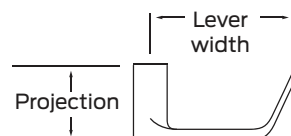
**ME2**  
▪ Handed



**ME3**

### Dimensions

Lever	Width	Projection
M63	4.6"	2.6"
M81	4.8"	2.5"
M82	4.9"	2.5"
M83	4.7"	2.25"
M84	5.1"	2.2"
M85	4.9"	2.7"
ME1	5.4"	2.6"
ME2	5.2"	2.4"
ME3	5"	2.8"



<sup>1</sup> Designed with Gensler as product design consultant

## Lever styles

### Standard levers



01



02

- Knurling available



03

- Knurling available



05



06

- Default lever
- Suites with Schlage Rhodes
- Knurling available



07

- Suites with Schlage Athens



12

- Handed

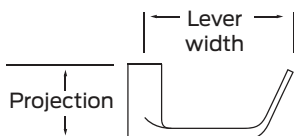


16

- Suites with Schlage Omega

### Dimensions

Lever	Width	Projection
01	4.0"	2.1"
02	4.75"	2.3"
03	4.75"	2.813"
05	3.75"	2.8"
06	4.7"	2.1"
07	4.6"	2.3"
12	4.3"	2.9"
16	5.05"	2.66"



## Lever styles

### Standard levers



**17**  
 ■ Suites with Schlage Sparta  
 ■ Knurling available



**18**



**Accent (ACC)**  
 ■ Handed



**Asti (AST)**  
 ■ Handed



**Merano (MER)**  
 ■ Handed



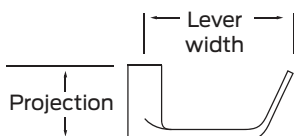
**Latitude (LAT)**



**Longitude (LON)**

### Dimensions

Lever	Width	Projection
17	4.7"	2.3"
18	4.75"	2.4"
Accent (ACC)	4.4"	3.1"
Asti (AST)	4.2"	2.5"
Merano (MER)	4.1"	2.5"
Latitude (LAT)	4.6"	2.3"
Longitude (LON)	4.9"	2.3"



## Electromechanical device options

### Switches

---

<b>LX</b>	<b>Latchbolt monitoring</b>
<b>LX-LC</b>	<b>Latchbolt monitoring, low current</b> <ul style="list-style-type: none"> <li>▪ Signals use of an opening</li> <li>▪ SPDT switch to monitor latch bolt</li> <li>▪ 2 A maximum @ 24VDC; below 50 mA @ 24VDC for low current option</li> </ul>
<b>RX</b>	<b>Request to exit</b>
<b>RXLC</b>	<b>Request to exit - low current</b>
<b>RX2</b>	<b>Double request to exit - 2 RX switches</b>
<b>WP-RX</b>	<b>Waterproof request to exit</b>
<b>RX-AUX</b>	<b>RX to RX-2 conversion</b> <ul style="list-style-type: none"> <li>▪ Signals use of an opening</li> <li>▪ SPDT switch to monitor pushpad</li> <li>▪ 2 A maximum @ 24VDC; below 50 mA @ 24VDC for low current option</li> </ul>
<b>LX-RX</b>	<b>Request to exit/latchbolt monitoring combination</b>
<b>LX-RX-LC</b>	<b>Request to exit/latchbolt monitoring combination, low current</b> <ul style="list-style-type: none"> <li>▪ 2 A maximum @ 24VDC; below 50 mA @ 24VDC for low current option</li> </ul>
<b>SS</b>	<b>Signal switch</b> <ul style="list-style-type: none"> <li>▪ Monitors pushpad and latchbolt</li> <li>▪ Signals unauthorized use of an opening</li> <li>▪ Switch makes latch bolt tamper-resistant</li> <li>▪ Up to 2.0 A @ 24VDC</li> </ul>

### Latch retraction

---

<b>EL</b>	<b>Electric latch retraction</b>
<b>SD-EL</b>	<b>Electric latch retraction with special center case dogging</b> <ul style="list-style-type: none"> <li>▪ Enables remote unlatching</li> <li>▪ Alternative to manual dogging</li> <li>▪ Voltage: 24VDC (continuous duty)</li> <li>▪ Current: 16.0 A inrush / 0.3 A holding</li> </ul>

<b>QEL</b>	<b>Quiet electric latch retraction</b>
<b>HD-QEL</b>	<b>Quiet electric latch retraction with hex dogging</b>
<b>SD-QEL</b>	<b>Quiet electric latch retraction with special center case dogging</b> <ul style="list-style-type: none"> <li>▪ Bolt retraction via switch</li> <li>▪ Converts exit door to push-pull operation</li> <li>▪ Voltage: 24VDC</li> <li>▪ Current: 1.0 A inrush (0.5 sec.) / 0.14 A holding</li> </ul>

### Delayed egress

---

<b>CX</b>	<b>Chexit delayed exit</b> <ul style="list-style-type: none"> <li>▪ Meets NFPA 101 requirements</li> <li>▪ Self-contained controls, locking, alarm</li> <li>▪ Input voltage: 24VDC</li> <li>▪ Input current inrush: 1.25 A</li> <li>▪ Input current holding: 390 mA</li> <li>▪ Alarm relay and secure relay contact ratings: 24 VDC, 1 A</li> </ul>
<b>CX-RCM</b>	<b>Chexit remote module</b> <ul style="list-style-type: none"> <li>▪ Chexit for smaller doors that can not accommodate a standard Chexit device</li> <li>▪ Size: 3.75" x 5.57" x 2.50"</li> <li>▪ Input voltage: 24VDC</li> <li>▪ Input current inrush: 1.25A</li> <li>▪ Input current holding: 390mA</li> <li>▪ Alarm relay and secure relay contact ratings: 24 VDC, 1 A</li> </ul>

### Miscellaneous

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<b>ALK</b>	<b>Alarm exit kit</b> <ul style="list-style-type: none"> <li>▪ Unauthorized opening triggers 85-decibel horn</li> <li>▪ Set in armed or disarmed mode by key</li> <li>▪ Assembly includes both a 24VDC input and external inhibit</li> </ul>
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## Electromechanical device options

- |              |   |
|--------------|---|
| <b>CON</b>   | <b>Allegion Connect</b> <ul style="list-style-type: none"><li>Common connectors to connect various door hardware all the way to the power supply</li></ul>  |
| <b>E996</b>  | <b>Electric locking and unlocking trim</b> <ul style="list-style-type: none"><li>Remains latched while unlocked</li><li>Remote electrical control</li><li>Voltage: 24VDC (Continuous Duty)</li><li>Current: 0.22 amps</li></ul> |
| <b>E7500</b> | <b>Electric mortise lock device</b> <ul style="list-style-type: none"><li>Voltage: 12 or 24VDC</li><li>Current: 0.60 amps @ 12VDC, 0.30 amps @ 24VDC</li></ul>  |

## Electromechanical device options

Matrix shows available options per device type but does not represent compatibility across multiple options.

	Switches									Latch retraction					Delayed egress		Misc			
	LX	LX-LC	RX	RXLC	RX2	WP-RX	LX-RX	LX-RX-LC	SS	EL	SD-EL	QEL	HD-QEL	SD-QEL	CX	CX-RCM	ALK	CON	E996	Mortise
98 99	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
98F 99F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
XP98 XP99		■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	
XP98-F XP99-F		■	■	■	■	■	■	■		■		■			■	■	■	■	■	
9875 9975			■	■	■	■		■		■	■	■	■	■	■	■	■	■	■	■
9875-F 9975-F			■	■	■	■		■		■		■			■	■	■	■	■	■
9827 9927	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9827-F 9927-F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
9857 9957	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9857-F 9957-F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
9847 9947	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9847-F 9947-F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
9848 9948	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9848-F 9948-F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
9849 9949	■ <sup>1</sup>	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9849-F 9949-F	■ <sup>1</sup>	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
9847WDC 9947WDC	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9847WDC-F 9947WDC-F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	
9850WDC 9950WDC	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9850WDC-F 9950WDC-F	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	

<sup>1</sup> For 98/9949 devices, LX switch monitors trim input or electric dogging of EL/QEL devices. LX switch does not monitor latchbolt condition.

## Mechanical device options

### Dogging

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- CD**      **Cylinder dogging, panic only**
- CD-CX**    **Center case cylinder dogging for Chexit devices**
- CI**      **Cylinder dogging indicator**
- Battery-operated dogging indicator in cylinder format with red light visible from over 75 feet away
- DI**      **Dogging indicator**
- Battery-operated dogging indicator in hex format with red light visible from over 75 feet away
- LD**      **Less dogging**
- SD**      **Special center case dogging**
- Center case cylinder dogging

### Classroom security

---

- 2**      **Double cylinder**
- Inside key cylinder locks/unlocks outside trim
- 2SI**    **Double cylinder with security indicator**
- Inside key cylinder locks/unlocks outside trim with visible indicators that provide status of door
- CDSI**    **Cylinder dogging with indicator**
- Provides visible lock/unlock indicators showing whether device is dogged or undogged
- HDSI**    **Hex dogging with indicator**
- Provides visible lock/unlock indicators showing whether device is dogged or undogged

### Environmental

---

- PN**      **Pneumatic latch retraction**
- For areas where electrical devices banned
  - Special linkage for mechanical or pneumatic dogging
- QM**      **Quiet mechanical option**
- Provides damper-controlled relatching of device
- INS**      **Insulclad kits**
- Kits with longer fasteners or parts for Insulclad doors
- AM**      **Anti-microbial finish**

### Weatherized

---

- WH**      **Weep holes**
- Drainage (weep) holes in mechanism case
- WS**      **Windstorm**
- Severe weather certified/tested
  - FEMA and ICC compliant
  - Tornado and hurricane tested

### California code

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- AX**      **Accessible device**
- UL certified to meet new 5 lb. maximum operating force requirement
  - Exceeds ANSI/BHMA requirements

### Latches

---

- PL**      **Pullman latch**
- Latches are always extended
  - Most commonly used in conjunction with electric strikes and LBR-less bottom rod application

## Mechanical device options

### Touch bar trim

---

- |                |  |
|----------------|--|
| <b>RSS</b>     | <b>Red silk screen</b> <ul style="list-style-type: none"><li>▪ Red silk-screened lettered touchbar trim</li></ul>  |
| <b>PUSH</b>    | <b>PUSH</b> <ul style="list-style-type: none"><li>▪ Touchbar trim embossed PUSH</li></ul>  |
| <b>SG</b>      | <b>Safety glow</b> <ul style="list-style-type: none"><li>▪ Self-illuminating touchpad</li><li>▪ Glows brightly during low or no light conditions</li></ul> |
| <b>KN</b>      | <b>Knurled touchbar</b> <ul style="list-style-type: none"><li>▪ Tactile warning applied to device</li></ul>  |
| <b>BRAILLE</b> | <b>Braille</b> <ul style="list-style-type: none"><li>▪ Vision impaired touchpad</li><li>▪ Raised letter and Braille</li></ul>                              |

## Mechanical device options

Matrix shows available options per device type but does not represent compatibility across multiple options.

	Dogging						Classroom security				Environmental				Weatherized		CA code
	CD	CD-CX	CI	DI	LD	SD	-2	-2SI	CDSI	HDSI	PN	QM	INS	AM	WH	WS	AX
98 99	■	■	■	■	■	■	■	■	■	■	■	■	■	■			■
98F 99F							■	■			■	■		■			■
XP98 XP99	■	■	■	■	■	■	■	■	■				■	■			■
XP98-F XP99-F							■	■					■	■			■
9875 9975	■	■	■	■	■	■	■		■	■			■	■			
9875-F 9975-F							■			■			■	■			
9827 9927	■	■	■	■	■	■			■	■	■	■	■	■	■		■ LBR
9827-F 9927-F										■	■		■	■	■		■ LBR
9857 9957	■	■	■	■	■	■			■	■	■		■	■	■		
9857-F 9957-F										■			■	■	■		
9847 9947	■	■	■	■	■	■			■	■	■		■	■			■ LBR
9847-F 9947-F										■			■	■			■ LBR
9848 9948	■	■	■	■	■	■			■	■	■		■	■			
9848-F 9948-F										■			■	■			
9849 9949	■	■	■	■	■	■			■	■	■	■	■	■			■ LBL
9849-F 9949-F										■			■	■			■ LBL
9847WDC 9947WDC	■	■	■	■	■	■			■	■	■		■	■			
9847WDC-F 9947WDC-F										■			■	■			
9850WDC 9950WDC	■	■	■	■	■	■			■	■	■		■	■			■ LBL
9850WDC-F 9950WDC-F										■			■	■			■ LBL

## Mechanical device options

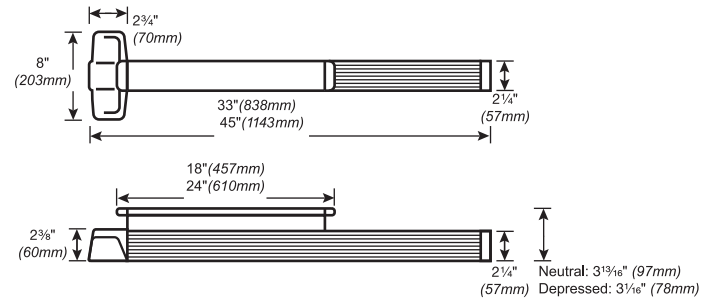
Matrix shows available options per device type but does not represent compatibility across multiple options.

	Latches	Touch bar trim				
	PL	RSS	PUSH	SG	KN	BRILLE
98 99		■	■	■	■	■
98F 99F		■	■	■	■	■
XP98 XP99		■	■	■	■	■
XP98-F XP99-F		■	■	■	■	■
9875 9975		■	■	■	■	■
9875-F 9975-F		■	■	■	■	■
9827 9927	■	■	■	■	■	■
9827-F 9927-F		■	■	■	■	■
9857 9957		■	■	■	■	■
9857-F 9957-F		■	■	■	■	■
9847 9947	■	■	■	■	■	■
9847-F 9947-F		■	■	■	■	■
9848 9948		■	■	■	■	■
9848-F 9948-F		■	■	■	■	■
9849 9949		■	■	■	■	■
9849-F 9949-F		■	■	■	■	■
9847WDC 9947WDC		■	■	■	■	■
9847WDC-F 9947WDC-F		■	■	■	■	■
9850WDC 9950WDC		■	■	■	■	■
9850WDC-F 9950WDC-F		■	■	■	■	■

## Specifications

Accessibility	<ul style="list-style-type: none"> <li>■ Force to depress push pad           <ul style="list-style-type: none"> <li>- AX device: 5 lbs</li> <li>- Standard device: 15 lbs</li> </ul> </li> <li>■ Push pad projection           <ul style="list-style-type: none"> <li>- Neutral: 3 <sup>13</sup>/<sub>16</sub>" (97 mm)</li> <li>- Depressed: 3 <sup>1</sup>/<sub>16</sub>" (78 mm)</li> </ul> </li> </ul>
Certifications/ approvals	All Von Duprin 98/99 exit devices are ANSI/BHMA Certified. Please refer to the BHMA Certified Products Directory for specific listings.
Mounting height	39 <sup>13</sup> / <sub>16</sub> " (1011 mm) 39 <sup>11</sup> / <sub>16</sub> " (1008 mm) with mullion
Warranty	36 months from the date of placing the product in operation

## Dimensions



**IVES****Vandal Resistant Trim****A**

Hinges &amp; Pivots

**B12**

Pulls &amp; Plates

**C**

Flush Bolts &amp; Coordinators

**D**

Latches, Catches &amp; Bolts

**E**

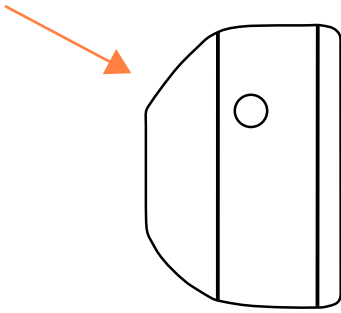
Stops

**F**

Exterior Hardware

**G**

Miscellaneous Hardware



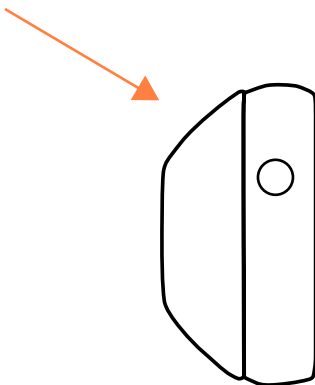
**VR900 RHR With black grip**  
**VR900 LHR With black grip**  
**VR904 RHR Without black grip**  
**VR904 LHR Without black grip**

- For use with most mortise locks on outswinging doors including Schlage L9000 Series with interior L or N escutcheon, and rose trim.
- Includes built-in lock protector and cylinder cutout.
- Handed design allows trim to be positioned to coordinate with the centerline of inside hardware.

Width	Height	Thru-Bolt Pattern	Clearance Grip to Door	Projection
7-1/4"	11"	2" wide x 10" high	1-1/2"	1-7/8"

**Finishes**

US Finish	US32D
BHMA	630



**VR900LLP RH With black grip**  
**VR900LLP LH With black grip**  
**VR904LLP RH Without black grip**  
**VR904LLP LH Without black grip**

- For use with most mortise locks on outswinging doors including Schlage L9000 Series with interior L or N escutcheon, and rose trim.
- Includes built-in lock protector and cylinder cutout.
- Handed design allows trim to be positioned to coordinate with the centerline of inside hardware.

Width	Height	Thru-Bolt Pattern	Clearance Grip to Door	Projection
5-1/4"	11"	1-3/4" wide x 10" high	1-1/2"	1-7/8"

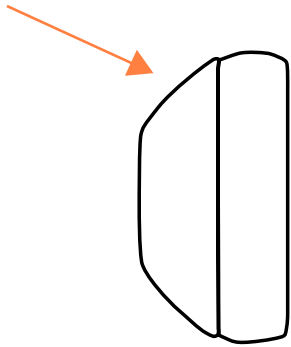
**Finishes**

US Finish	US32D
BHMA	630

**B12**



# Vandal Resistant Trim **IVES**



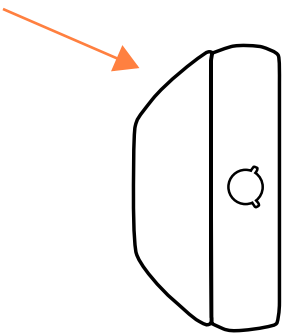
## VR910-DT **With black grip** VR914-DT **Without black grip**

- For use with Von Duprin 98/99 Series rim and vertical rod exit device
- Non-handed
- Thru-bolts direct to the exit device
- Pull operation only.

Width	Height	Thru-Bolt Pattern	Clearance Grip to Door	Projection
5-1/4"	11"	1-3/8" wide x 7" high	1-1/2"	1-7/8"

### Finishes

US Finish	US32D
BHMA	630



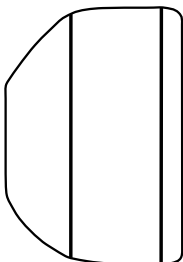
## VR910-NL **With black grip** VR914-NL **Without black grip**

- For use with Von Duprin 98/99 rim and vertical rod exit device
- Non-handed
- Thru-bolts direct to the exit device

Width	Height	Thru-Bolt Pattern	Clearance Grip to Door	Projection
5-1/4"	11"	1-3/8" wide x 7" high	1-1/2"	1-7/8"

### Finishes

US Finish	US32D
BHMA	630



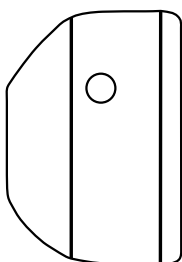
## VR910M-DT **With black grip** VR914M-DT **Without black grip**

- For use with Von Duprin 9875/9975 mortise lock exit device
- Non-handed
- Thru-bolts direct to the exit device

Width	Height	Thru-Bolt Pattern	Clearance Grip to Door	Projection
7-1/4"	11"	1-3/8" wide x 7" high	1-1/2"	1-7/8"

### Finishes

US Finish	US32D
BHMA	630



## VR910M-NL RHR **With black grip** VR910M-NL LHR **With black grip** VR914M-NL RHR **Without black grip** VR914M-NL LHR **Without black grip**

- For use with Von Duprin 9875/9975 Series mortise lock exit device
- Thru-bolts direct to the exit device
- Night latch operation (cylinder not furnished)

Width	Height	Thru-Bolt Pattern	Clearance Grip to Door	Projection
7-1/4"	11"	1-3/8" wide x 7" high	1-1/2"	1-7/8"

### Finishes

US Finish	US32D
BHMA	630

Hinges &amp; Pivots

A

Pulls &amp; Plates

B13

Flush Bolts &amp; Coordinators

C

Latches, Catches &amp; Bolts

D

Stops

E

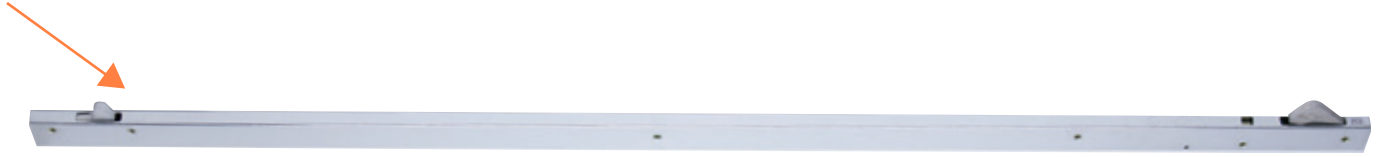
Exterior Hardware

F

Miscellaneous Hardware

G

B13

**IVES****Coordinators –  
Bar Coordinators and Filler Bars****A**  
Hinges & Pivots

Meets ANSI/BHMA A156.3, Type 21A.  
UL Listed for installation on labeled frame.

**COR Series Bar Coordinators**

- The COR Series Coordinators are designed for use on pairs of doors when one door needs to close before the other.
- All COR units function easily. The active door lever, located nearest to the active stop, holds the active door open until the trigger mechanism is released by the closing of the inactive leaf.
- All COR units may not function correctly with swingclear hinges.
- All COR units are equipped with an adjustable override feature which allows the active door to close under extreme pressure.
- All COR units are compatible with Flush Bolts.
- The COR Series is available in five sizes for variable door opening widths.
- The COR Series does not cover the entire length of the stop, so a FL filler bar can be provided to maintain architecturally clean lines.
- COR Series Coordinator Channels and FL fillers are made of aluminum.
- Optional Filler Bars: FL20 - 20", FL32 - 32" and FL44 - 44", available to maintain clean line.
- Optional Mounting Brackets available: MB1, MB2, MB1F, MB2F, MB3F, MB1V, MB2V, and MB3V for other stop applied hardware.

**For Openings Where Doors Are Same Size**

Coordinator Number	Length of Channel	For Opening Widths	Common Applications
COR32	32"	34" - 52"	Pair of 2'0" Doors
COR42	42"	52" - 72"	Pair of 2'6" Doors
COR52	52"	62" - 92"	Pair of 3'0" Doors
COR60	60"	70" - 108"	Pair of 3'6" Doors
COR72	72"	84" - 132"	Pair of 4'0" Doors

**For Openings Where Doors Are Unequal Size**

The coordinator length should equal the active door width plus approximately 1/2 the inactive door width. The coordinator must be 6" longer than the active door width and shorter than the overall frame opening between stops.

**B**  
Pulls & Plates**C12**  
Flush Bolts & Coordinators**D**  
Latches, Catches & Bolts**E**  
Stops**F**  
Exterior Hardware**G**  
Miscellaneous Hardware**FL****Series Filler Bars**

- The FL Filler Bars are available in three sizes for variable frame openings.
- FL Filler Bars are made of aluminum
- FL Filler Bars are field sized to frame opening.

**Filler Bar Number**

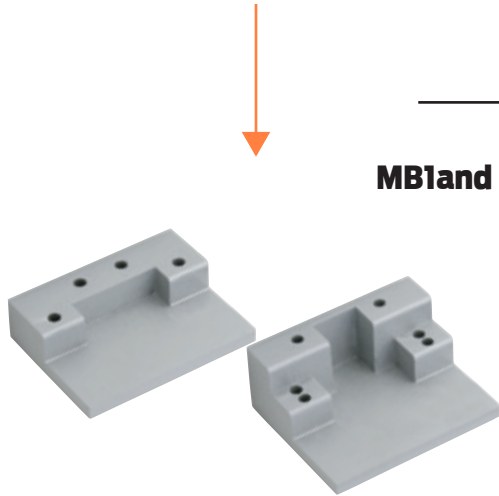
Filler Bar Number	Length	Dimensions
FL20	20"	1-5/8" W x 5/8" D x 20" L
FL32	32"	1-5/8" W x 5/8" D x 32" L
FL44	44"	1-5/8" W x 5/8" D x 44" L

**Finishes**

Ives Finish	US28	US26D	315AN
BHMA	628	713	711

## Coordinators – Mounting Brackets

# IVES®



**MB1 and MB2**

### Mounting Brackets

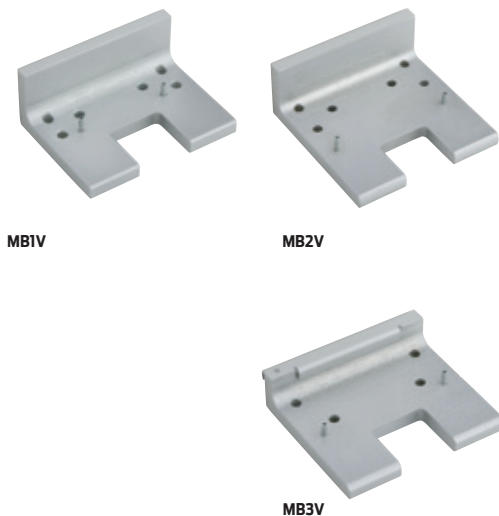
- Allows stop mounted hardware to be properly installed without damaging the COR coordinator, such as a parallel arm closer or a non-fire-rated surface vertical rod strike.
- Stop mounted hardware will need to be lowered to compensate for the height of the coordinator and mounting bracket.
- MB mounting brackets are made of aluminum

Product	Jamb Depth	Stop Width	Dimensions
MB1	4-3/4" Min.	Over 2-1/2"	4" W x 3" D x 15/16" T
MB2	4-3/4" Min.	Up to 2-1/2"	4" W x 3-1/4" D x 1-5/8" T

### Finishes

Ives Finish	USP	SP28	SPBLK
BHMA	600	689	622

**MB1F, MB2F and MB3F  
MB1V, MB2V and MB3V**



MB1V

MB2V

MB3V

### Fire Rated Mounting Brackets

- Allows for fire-rated stop mounted hardware to be properly installed without damaging the COR Coordinators, such as fire-rated surface vertical rod exit device strikes.
- Latch will need to be lowered to compensate for the height of the coordinator and mounting bracket.
- MB-V are designed for Von Duprin 8827-F soffit latch.
- Mounting brackets are made of steel.

Product	Jamb Depth	Stop Width	Dimensions
MB1F	5"	1-1/2" - 2-1/4"	4" W x 3" D x 1-5/8" T
MB1V	5"	1-1/2" - 2-1/4"	4" W x 3" D x 1-5/8" T
MB2F	5-7/8"	2-3/8" - 3-1/4"	4" W x 4" D x 1-5/8" T
MB2V	5-7/8"	2-3/8" - 3-1/4"	4" W x 4" D x 1-5/8" T
MB3F	6-7/8"	Over 3-3/8"	4" W x 3-1/2" D x 1" T
MB3V	6-7/8"	Over 3-3/8"	4" W x 3-1/2" D x 1" T

### Finishes

Ives Finish	USP	SP28	SPBLK
BHMA	600	689	622

A  
Hinges & Pivots

B  
Pulls & Plates

C13  
Flush Bolts & Coordinators

D  
Latches, Catches & Bolts

E  
Stops

F  
Exterior Hardware

G  
Miscellaneous Hardware

C13

**IVES****Coordinators –  
Gravity Coordinators****A**  
Hinges & Pivots**B**  
Pulls & Plates**C14**  
Flush Bolts & Coordinators**D**  
Latches, Catches & Bolts**E**  
Stops**F**  
Exterior Hardware**G**  
Miscellaneous Hardware**COR7G and  
COR9G**

Meets ANSI/BHMA A156.3, Type 21.  
UL Listed for Fire Doors.

**Gravity Coordinators**

- When active door is open, coordinator prevents active door from closing until inactive door bypasses. Closing of inactive door causes strike plate on top of door to contact cam and lift arm, allowing active door to close. As inactive door continues closing, roller rides over strike plate on to door bracket, holding arm above active door.
- Non-handed.
- Gravity action arm and door bracket are adjustable on the job for ease of installation. Rubber roller provides quiet and efficient operation, and helps protect the astragal and doors from damage.
- Nylon roller on short arm glides smoothly over door bracket and strike, ensuring silent operation.
- Made of forged brass.
- COR7G for use on pairs of doors with astragal on active door up to 4' or with astragal on inactive door up to 3'4" or with astragal on both doors up to 2'10"
- COR9G for use on pairs of doors with astragal on active over 4' or with astragal on inactive door over 3'4" or with astragal on both doors over 2'10"

Product	Projection
COR7G	7"
COR9G	9"

**Finishes**

Ives Finish	US3	US4	US10	US10B	US26	US26D
BHMA	605	606	612	613	625	626



Meets ANSI/BHMA A156.3, Type 21.

**CB1 Carry Bar**

- Used when it is possible for the inactive door to be opened before the active door.
- Prevents damage to the doors and other hardware.
- Nylon roller insures quiet and efficient operation.
- Non-handed.
- All-steel construction.
- Standard sex bolts for mounting.

**Finishes**

Ives Finish	US3	US4	US10	US10B	US26	US26D	SPBLK	USP
BHMA	605	606	612	613	625	626	622	600

**C14**

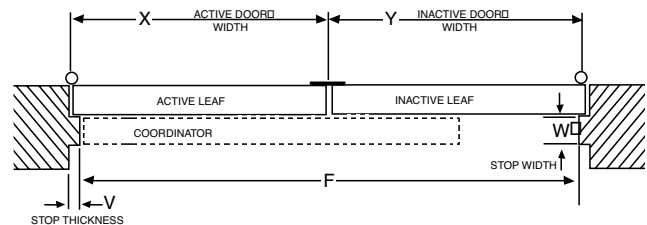
Ives Architectural hardware products

## How to Order COR and Accessories

<b>COR</b>	<b>52</b>	<b>US28</b>	<b>FL20</b>	<b>D</b>	<b>36"</b>
<b>COR Size:</b> 32, 42, 52, 60, 72					
<b>Finishes:</b> US28, US26D, 315AN					
<b>Filler Bar (if desired):</b> FL20, FL32, FL44					
<b>Vertical Rod Exit Device Cutout Type (if applicable):</b> A, B, C, D, E, F, G If other Vertical Rod Exit Device not listed on chart, from page C16, include information as shown on page C16.					
<b>Active Door Size – Required for ALL Vertical Rod Exit Device Applications</b>					

### To determine the size COR you need:

1. Start with the active door width (X).
2. Next consider the overall frame opening between stops (F).
3. Preferably, the coordinator would equal the active door width (X) + approximately 1/2 inactive door width (Y).  
The coordinator must be 6" longer than the active door width (X) and less than the overall frame opening between stop (F).



### Examples:

- Pair of 30" Doors, 5/8" Stops  
Active Door Size, X = 30"  
Overall Frame Opening between Stops, F = 58-3/4"  
Recommended Coordinator: COR42
- 36" Active Door, 18" Inactive door, 5/8" Stops  
Active Door Size, X = 36"  
Overall Frame Opening between Stops, F = 52-3/4"  
Recommended Coordinator: COR42
- Pair of 36" Doors, 5/8" Stops  
Active Door Size, X = 36"  
Overall Frame Opening between Stops, F = 70-3/4"  
Recommended Coordinator: COR52
- 48" Active Door, 24" Inactive Door, 5/8" Stops  
Active Door Size, X = 48"  
Overall Frame Opening between Stops, F = 94-3/4"  
Recommended Coordinator: COR60

A  
Hinges & Pivots

B  
Pulls & Plates

C15  
Flush Bolts & Coordinators

D  
Latches, Catchers & Bolts

E  
Stops

F  
Exterior Hardware

G  
Miscellaneous Hardware

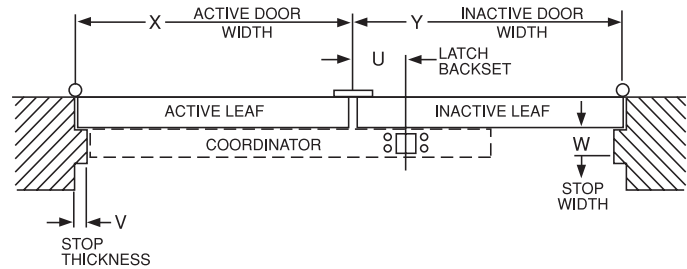
# IVES® Coordinators

## Special Factory Preparation for Use with Vertical Rod Exit Devices

Coordinators may need to be prepared at the factory for use with some surface or concealed vertical rod exit devices. (See Chart below)

### If the exit device is not listed the following information is needed.

1. Exit Device Manufacturer and Model No.
2. Active Door Size, "X"
3. Inactive Door Size, "Y"
4. Exit Device Backset, "U"
5. Stop Width, "W"
6. Stop Thickness if other than 5/8", "V"



Exit Device Manufacturer	Exit Device Number	Device Backset	Maximum Active Door	Coordinator Size Needed	Coordinator Cutout Type	Mounting Bracket Needed
Von Duprin	5547-F	2-3/8"	33" 43" 51" 63"	42" 52" 60" 72"	Type A	None
Von Duprin	8827-F	2-3/4"	33" 43" 51" 63"	42" 52" 60" 72"	Type B	MB1V, MB2V or MB3V see page C3
Von Duprin	8847-F	2-3/8"	33" 43" 51" 63"	42" 52" 60" 72"	Type C	None
Von Duprin	33/3547 33/3547-F 98/9947 98/9947-F	2-3/4"	33" 43" 51" 64"	42" 52" 60" 72"	Type D	None
Von Duprin	33/3548 33/3548-F 98/9948 98/9948-F	2-3/4"	33" 43" 51" 64"	42" 52" 60" 72"	Type D	None
Von Duprin	33/3547WDC 33/3547WDC-F 98/9947WDC 98/9947WDC-F	1-5/16"	34" 44" 52" 65"	42" 52" 60" 72"	Type E	None
Falcon	17-C F-17-C 18-C F-18-C XX-C F-XX-C 24-C F-24-C 25-C F-25-C	2-3/4"	33" 43" 51" 63"	42" 52" 60" 72"	Type F	None
Falcon	17-C-WDC F-17-C-WDC 18-C-WDC F-18-C-WDC XX-C-WDC F-XX-C-WDC 24-C-WDC F-24-C-WDC 25-C-WDC F-25-C-WDC	2-13/16"	33" 43" 51" 63"	42" 52" 60" 72"	Type G	None

# 90 Series Surface Overhead Door Holders/Stops



## 90 Series Heavy-Duty

Glynn-Johnson 90 series holders and stops are the most rugged models available for heavy-duty applications. The channel is surface-mounted to the door, most often with six bolts, and the jamb bracket is surface mounted to the jamb, requiring minimal door and frame preparation.

These versatile units can be used in conjunction with most surface-applied door closers. The provided templates allow for variable mounting positions, ranging from 85° to 110° Hold-Open/Stop angle. These templates are designed for installation in almost all types of doors, including doors with conventional butt-type hinges or specialty hinges.

### Four Models:

- 90H Series Hold-Open Model
- 90S Series Stop-Only Model
- 90F Series Friction Hold-Open Model
- 90SE Series Special Stop-Only Model

### Five Sizes:

- Simple
- Standardized
- Each model is available in five sizes

### Three Options:

- J—Angle Jamb Bracket
- SHIM—Blade Stop Shim Kits
- SOC—Pin-in-Socket Security Screw Package

### Unmatched Convenience:

- Non-Handed
- Improved Compatibility with Door Closers
- Single-Acting Doors
- Interior/Exterior Applications
- Durable
- Easy to Install
- Improved Corrosion Resistance
- Function Conversion Kits Available

### Materials and Finishes:

In 300 series Stainless Steel, Brass and Steel substrates, these models are available in the largest selection of finishes in the industry. Stainless Steel models offer the highest resistance to corrosion. Available in the following finishes:

Finish	Description
US3	Polished Brass
US4	Satin Brass
US10	Satin Bronze
US10B	Oil Rubbed Bronze
US32	Polished Stainless Steel
US32D	Satin Stainless Steel
SP4	Powder Coat Brass
SP10	Powder Coat Bronze
SP28	Powder Coat Aluminum
SP313	Powder Coat Dark Bronze
SPBLK	Powder Coat Black
652	Chrome-like Coating

## Models

Glynn-Johnson 90 series door holders and stops provide long-lasting protection for doors, frames and hardware. All models incorporate a heavy-duty channel/slide-arm design and offset jamb bracket. This unique design allows for simple field modification of functions, should user requirements change.

### 90H Series Hold-Open

(Suffix H) Hold-Open models provide a convenient method of holding the door open at a predetermined position for short or long periods of time, permitting an unobstructed traffic flow through the opening. The Hold-Open function can easily be turned on or off by simply rotating the serrated knob on the bottom of the channel. This knob engages the Hold-Open mechanism, allowing the door to be held open at a predetermined position ranging from 85° to 110°. When the knob is flipped over, it acts as a stop and shock absorber.

The tension on the Hold-Open mechanism can be adjusted using a phillips screwdriver to offset air currents or other exterior conditions. The Hold-Open tension adjustment is located on the top of the slider in the channel.

### 90S Series Stop-Only

(Suffix S) When the Hold-Open function is not a requirement, Stop-Only models provide a reliable method of door control. Stop-Only models provide the same shock-absorbing capability as Hold-Open models. The Stop-Only model may be used on fire doors.

### 90F Series Friction Hold-Open

(Suffix F) Friction Hold-Open models are ideal for patient room doors, wardrobe and closet doors or similar applications where multiple Hold-Open positions are desired. The friction tension can be adjusted through the top of the channel using an allen wrench. The friction tension adjustment is located on the top of the slider in the channel.

## 90SE Series Special Stop-Only

(Suffix SE) When Stop-Only models are used in conjunction with single-point, Hold-Only electronic door closers, the Stop-Only function may be ordered without the shock-absorbing mechanism. Used as an auxiliary stop, these models prolong the life of the closer. The stop location is adjusted using an allen wrench on the stop block located in the channel.

*Note: Caution should be taken when using this option in other applications, as the elimination of the shock-absorbing spring can put added stress on the door and frame.*

## Application Information

### UL Classification

The 90 series Stop-Only models are classified by Underwriters Laboratories (UL) as Miscellaneous Fire Door Accessories. This classification applies to use on either Hollow Metal Fire Doors or Wood Fire Doors. These units may be used on doors of any rating. As a reminder, the Miscellaneous Fire Door Accessories (GVUX) section is defined by UL as: "Miscellaneous fire door accessories are intended in the individual Listings. The accessories have been investigated to determine that when installed in accordance with the manufacturer's instructions, the accessories do not adversely affect the fire rating of the fire door and/or fire door frames."

### Dead-Stop Templating:

Dead-stop templating is recommended for applications where a wall or similar obstruction is placed at an opening angle of 110° or less (i.e., doors that open back-to-back). Dead-stop templating can be applied to Hold-Open, Stop-Only and Friction models. The Dead-Stop position is the point at which the shock-absorbing spring is fully compressed. Therefore, when Dead-Stop Templating is used, the initial degree of opening will be 5° to 7° less than the Dead-Stop opening.

*Example: If the holder is templated to a 100° Dead Stop, the door will hold open at an angle between 93° and 95° but no further than 100°*

*Note: Do not use dead-stop templating on the 90SE Series since there is no shock-absorbing spring.*

### Environmental Considerations:

Environmental factors should always be considered when specifying overhead holders and stops. Doors that are positioned on a building's exterior or subject to corrosive conditions should be equipped with a holder constructed primarily of stainless steel or brass materials. For interior applications, steel is acceptable, though brass substrates generally provide a more attractive architectural-grade finish.

### Function Conversion Kits

- FK90H—Converts a 90F or a 90S unit into a 90H unit. To order specify FK90H.
- FK90F—Converts a 90H or a 90S unit into a 90F unit. To order specify FK90F.
- FK90SE—Converts a 90H, 90F or a 90S unit into a 90SE unit. To order specify FK90SE—Finish.
- No kit is needed to convert a 90H or 90F unit into a 90S unit.

## Options

### Suffix J (Angle Jamb Bracket):

An angle jamb bracket is available for converting standard models to hinge-side or flush transom mounting. The angle jamb bracket affixes to the standard jamb bracket. If ordered with the unit add suffix J. If needed separately order 90J by finish needed.

### Suffix SOC (Pin-in-Socket Security Screws):

A screw package with pin-in-socket screws for mounting the door bracket and the jamb bracket is provided instead of the standard screw package.

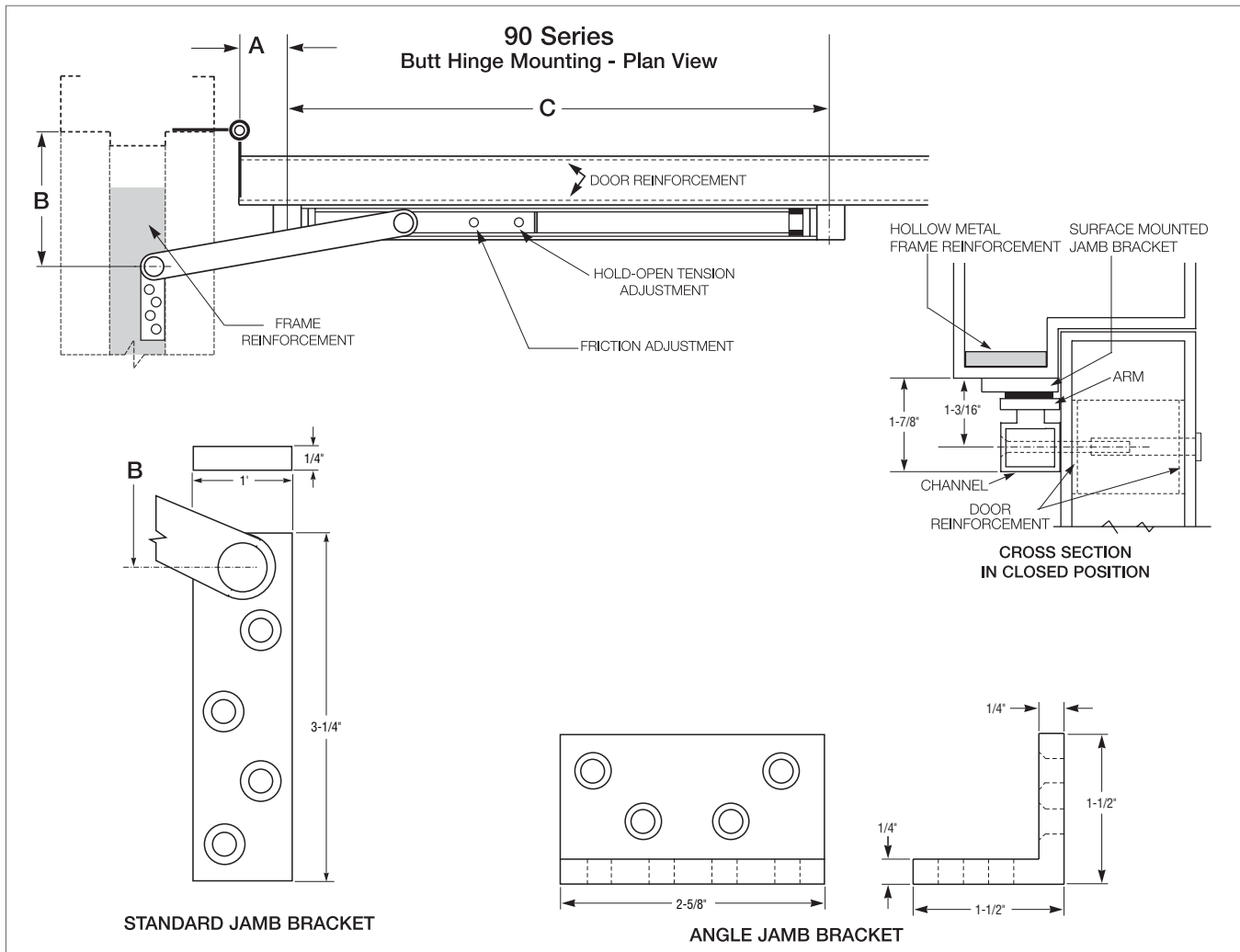
### Suffix SHIM (Blade Stop Shims):

Shim kits are available in 3 sizes  
 90 SHIM1 is a 1/4" Shim Kit  
 90 SHIM2 is a 1/2" Shim Kit  
 90 SHIM3 is a 3/4" Shim Kit

If ordered with overhead, add suffix SHIM (1, 2 or 3). If needed separately order 90 SHIM (1, 2 or 3)—Finish.



# 90 Series Surface Overhead Door Holders/Stops



SIZE	BUTTS/OFFSET PIVOTS				CENTER HUNG			
	DOOR OPENING	STOP ONLY	HOLD OPEN	FRICTION	DOOR OPENING	STOP ONLY	HOLD OPEN	FRICTION
1	----	----	----	----	----	----	----	----
2	23-1/16"-27"	902S	902H	902F	27-1/16"-33"	902S	902H	902F
3	27-1/16"-33"	903S	903H	903F	33-1/16"-39"	903S	903H	903F
4	33-1/16"-39"	904S	904H	904F	39-1/16"-45"	904S	904H	904F
5	39-1/16"-45"	905S	905H	905F	45-1/16"-51"	905S	905H	905F
6	45-1/16"-51"	906S	906H	906F	51-1/16"-59"	906S	906H	906F

G-J Model	BHMA*	FED. Spec.
902 - 906H	C02511	1161
902 - 906S	C02541	1161A
902 - 906F	C02531	---

\* First numeral (0) designates optional material.  
 To specify:  
 Brass material, change 0 to 1 (i.e. C12511)  
 Stainless Steel material, change 0 to 5 (i.e. C52511)  
 Steel material, change 0 to 8 (i.e. C82511)

Note: This chart illustrates the most common types of hinging and door opening sizes.  
 For unusual door details, contact Glynn-Johnson for availability.

The template information on this page is for reference only and is not intended to serve as an installation template.  
 For complete dimensional information, refer to Glynn-Johnson template book.



## How to Order

**90**      **4**      **H**      -      **US32D**      -      **J**

**Overhead Series:**  
90

**Size (Door Opening Using Butts or Offset Pivots):**  
**2**      (23-1/16"-27")  
**3**      (27-1/16"-33")  
**4**      (33-1/16"-39")  
**5**      (39-1/16"-45")  
**6**      (45-1/16"-54")

**Function:**  
**H**      Hold-Open  
**F**      Friction Hold-Open  
**S**      Stop-Only  
**SE**      Special Stop-Only

**Finishes:**  
**US3**      Polished Brass  
**US4**      Satin Brass  
**US10**      Satin Bronze  
**US10B**      Oil Rubbed Bronze  
**US32**      Polished Stainless Steel  
**US32D**      Satin Stainless Steel  
**SP4**      Powder Coat Brass  
**SP10**      Powder Coat Bronze  
**SP28**      Powder Coat Aluminum  
**SP313**      Powder Coat Dark Bronze  
**SPBLK**      Powder Coat Black  
**652**      Chrome-like Coating

**Options:**  
**J**      Angle Jamb Bracket  
**SHIM**      Blade Stop Shims—  
             SHIM1-1/4" Kit  
             SHIM2-1/2" Kit  
             SHIM3-3/4" Kit  
**SOC**      Pin-in-Socket Security Screws

# 100 Series Concealed Overhead Door Holders/Stops



## 100 Series Heavy-Duty

Glynn-Johnson offers a complete line of overhead door holders and stops, accommodating virtually all openings with solutions for even the most complex door control problems. These concealed holders and stops provide the most attractive and reliable heavy-duty door control available.

Glynn-Johnson 100 series holders and stops provide the most reliable and versatile concealed overhead door control. They are designed for installation on virtually all types of doors mounted on conventional type butt hinges, pivots, continuous hinges, swing clear hinges and numerous other specialty hinges. When used in conjunction with many surface-applied door closers, 100 series holders and stops provide the most effective control for entrance doors and vestibule doors of all types, as well as heavy or often used interior doors. Templates provided allow for variable mounting positions, ranging from 85° - 110° of opening.

### Five Models:

- 100H Series Hold-Open Model
- 100HP Series Internal Hold-Open Model
- 100F Series Friction Hold-Open Model
- 100S Series Stop-Only Model
- 100SE Series Special Stop-Only Model

### Six Sizes:

- Each model comes in six sizes.
- Simple
- Standardized

### Three Options:

- ADJ—Adjustable Jamb Bracket
- CJ—Jamb Bracket for use with LCN5030 Closer
- SOC—Pin-in-Socket Security Screw Package

### Unmatched Convenience:

- Non-handed
- Improved Compatibility with Door Closers
- Single/Double-Acting Doors
- Interior/Exterior Applications
- Reduced Door Prep
- Durable
- Improved Corrosion Resistance
- Function Conversion Kits are Available.

### Materials and Finishes:

In Heavy Gauge Brass or 300 Series Stainless Steel, these models offer the broadest range of finishes in the industry, complementing any design and offering the highest resistance to corrosion. Available in the following finishes:

Finishes	Description
US3	Polished Brass
US4	Satin Brass
US10	Satin Bronze
US10B	Oil Rubbed Bronze
US32	Polished Stainless Steel
US32D	Satin Stainless Steel
SP4	Powder Coat Brass
SP10	Powder Coat Bronze
SP28	Powder Coat Aluminum
SP313	Powder Coat Dark Bronze
SPBLK	Powder Coat Black

## Models

These models provide a wide range of optional features, and are ideal for use on entrance and vestibule doors, large doors, doors opened frequently, or doors subject to abuse. These models are also furnished with an offset-style jamb bracket.

Designed for heavy-duty applications, 100 series models will provide long-lasting protection to doors, frames, hinges, related hardware and surrounding walls or obstructions.

### 100H Series Hold-Open

(Suffix H) The Hold-Open function should be used where it is desired to hold a door open at a predetermined position for short or long periods of time, permitting an unobstructed traffic flow through the opening.

These models are both selective and adjustable, featuring the most reliable Hold-Open mechanism available. They feature a control knob which protrudes from the face of the door and turns the Hold-Open function on or off. Set in the inactive position, the unit acts as a stop and shock absorber. The tension on the Hold-Open mechanism can be adjusted using an allen wrench to offset air currents or other exterior conditions. The Hold-Open tension adjustment is located in the bottom of the track in the top of the door.

### 100HP Series Internal Hold-Open

These models provide a Hold-Open unit with the Hold-Open mechanism built into the channel, thus reducing the door prep. The 100HP have a preset Hold-Open force that is not adjustable. The Hold-Open feature is not selectable in these units, so the doors are always held open.

### 100F Series Friction Hold-Open

(Suffix F) Friction Hold-Open models provide an alternative holding method, ideal for heavy patient room doors, closet doors or similar applications where multiple Hold-Open positions are desired. The friction tension is adjusted using an allen wrench and an open end wrench. The friction tension adjustment is located on the top of the slider in the channel.

### 100S Series Stop-Only

(Suffix S) When the Hold-Open function is not required, the Stop-Only function provides the same effective door control minus the Hold-Open feature. The Stop-Only model may be used on fire doors.

### 100SE Series Special Stop-Only

(Suffix SE) When Stop-Only models are used in conjunction with single point Hold-Open electronic door closers, they may be ordered without the shock-absorbing mechanism. Used as an auxiliary stop with these closers, they will prolong the life of the closer. The stop location is adjusted using an allen wrench on the stop block located in the channel.

*Note: Caution should be used when using this option in other applications, as the elimination of the shock-absorbing spring can put added stress on door and frame if used improperly.*

## Application Information

### UL Classification

The 100 series Stop-Only models are classified by Underwriters Laboratories (UL) as Miscellaneous Fire Door Accessories. This classification applies to use on either Hollow Metal Fire Doors or Wood Fire Doors. Where Wood Door manufacturer's listing allows for the cutout required for installation, concealed overhead stops may be used on those wood fire doors. These units may be used on doors of any rating. As a reminder, the Miscellaneous Fire Door Accessories (GVUX) section is defined by UL as: "Miscellaneous fire door accessories are intended in the individual Listings. The accessories have been investigated to determine that when installed in accordance with the manufacturer's instructions, the accessories do not adversely affect the fire rating of the fire door and/or fire door frames."

### Dead Stop Templating:

If a wall or similar obstruction is in place at 110° or less opening angle (i.e. doors that open back-to-back), Dead Stop Templating should be used. This includes all Hold-Open, Friction and Stop-Only models, except when the "SE" Option is used. The Dead Stop position is reached when the shock-absorbing spring is fully compressed, the initial degree of opening will be 5° to 7° less than the Dead Stop opening.

*Example: If the holder is templated to 100° Dead Stop, the door will hold open somewhere between 93° and 95°, but no further than 100°.*

*Note: Do not use dead-stop templating on the 100SE Series since there is no shock-absorbing spring.*

### Environmental Considerations:

Environmental factors should always be considered when specifying overhead holders and stops. Doors that are positioned on a building's exterior or subject to corrosive conditions should be equipped with a holder constructed primarily of stainless steel or brass materials. For interior applications, steel is acceptable, though brass substrates generally provide a more attractive architectural-grade finish.

### Function Conversion Kits

- FK100F—Converts a 100H or 100S unit into a 100F unit.  
To order specify FK100F.
- FK100H—Converts a 100F or 100S unit into a 100H unit.  
To order specify FK100H.
- No kit is needed to convert a 100H or 100F unit into a 100S unit.

## Options

### Suffix ADJ (Adjustable Jamb Bracket):

An additional option on the 100 series is the adjustable jamb bracket, which allows the degree of Hold-Open or Stop angle to be adjusted after installation. Suffix "ADJ" is available in all functions, but only in sizes 3, 4, 5 & 6. ADJ jamb bracket requires additional frame prep. The ADJ option cannot be added to an existing unit, it must be factory ordered.

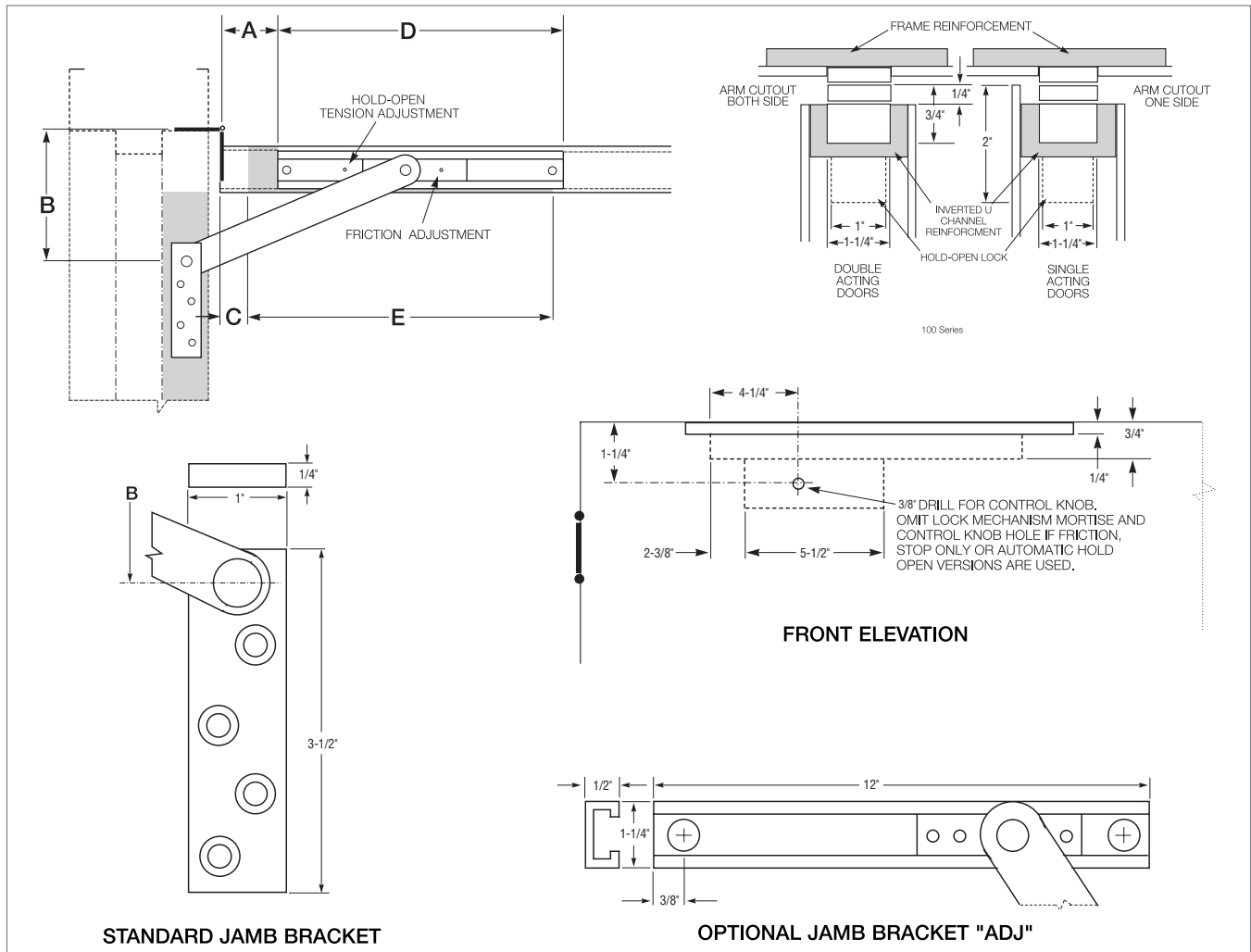
### Suffix CJ (Closer Jamb Bracket):

Provides a special jamb bracket needed for 100 series units used with LCN5030 closers. These special jamb brackets are handed, so handing will need to be specified when ordering the "CJ" option, CJLH for a left hand door and CJRH for a right hand door. The CJ option cannot be added to an existing unit, it must be factory ordered.

### Suffix SOC (Pin-in-Socket Security Screw Package):

A screw package with pin-in-socket screws for mounting the jamb bracket to the frame is provided instead of the standard screw package.

# 100 Series Concealed Overhead Door Holders/Stops



SIZE	BUTTS/OFFSET PIVOTS				CENTER HUNG			
	DOOR OPENING	STOP ONLY	HOLD OPEN	FRICTION	DOOR OPENING	STOP ONLY	HOLD OPEN	FRICTION
1	18"-23"	101S*	101H*	101F*	----	----	----	----
2	23-1/16"-27"	102S*	102H*	102F*	----	----	----	----
3	27-1/16"-33"	103S	103H	103F	33-1/16"-39"	103S	103H	103F
4	33-1/16"-39"	104S	104H	104F	39-1/16"-45"	104S	104H	104F
5	39-1/16"-45"	105S	105H	105F	45-1/16"-51"	105S	105H	105F
6	45-1/16"-54"	106S	106H	106F	51-1/16"-59"	106S	106H	106F

Note: This chart illustrates the most common types of hinging and door opening sizes. For unusual door details, contact Glynn-Johnson for availability.

\*These sizes are not available for use with offset pivots. Also not available with the ADJ option.

G-J Model	BHMA*	FED. Spec.
101-106 H	C01511	1160
101-106 S	C01541	----
101-106 F	C01531	----

\* First numeral (0) designates optional material.

To specify:

Brass material, change 0 to 1 (i.e. C11511)

Stainless Steel material, change 0 to 5 (i.e. C51511)

## BHMA

All 100 series models are designed for heavy-duty applications and far exceed BHMA cycle test and force test requirements for Grade 1 holders and stops.

The template information on this page is for reference only and is not intended to serve as an installation template. For complete dimensional information, refer to Glynn-Johnson template book.



## How to Order

**10**      **4**      **H**      -      **US26D**      -      **ADJ**

**Overhead Series:**  
10

**Size (Door Opening Using Butts or Offset Pivots:**  
**1**      (18"-23")  
**2**      (23-1/16"-27")  
**3**      (27-1/16" -33")  
**4**      (33-1/16"-39")  
**5**      (39-1/16"-45")  
**6**      (45-1/16"-54")

**Function:**  
**H**      Hold-Open  
**HP**    Internal Hold-Open  
**F**      Friction Hold-Open  
**S**      Stop-Only  
**SE**    Special Stop-Only

**Finishes:**  
**US3**    Polished Brass  
**US4**    Satin Brass  
**US10**   Satin Bronze  
**US10B** Oil Rubbed Bronze  
**US32**   Polished Stainless Steel  
**US32D** Satin Stainless Steel  
**SP4**    Powder Coat Brass  
**SP10**   Powder Coat Bronze  
**SP28**   Powder Coat Aluminum  
**SP313** Powder Coat Dark Bronze  
**SPBLK** Powder Coat Black

**Options:**  
**ADJ**    Adjustable Jamb Bracket  
**CJLH**   Special Jamb Bracket for LCN 5030 Closer, LH Door  
**CJRH**   Special Jamb Bracket for LCN 5030 Closer, RH Door  
**SOC**    Pin-in-Socket Security Screws



### Surface mounted closer

## 4040XP Series

### Overview

The 4040XP is LCN's most durable and flexible heavy duty closer designed for institutional and other demanding high traffic applications.



### Cylinder

#### 4040XP-3071

Cast iron cylinder assembly

#### Handing

Non-handed

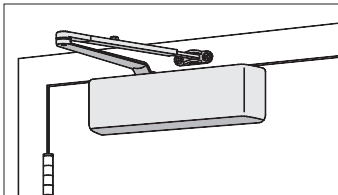
#### Sizing

Adjustable spring size 1-6,  
includes patented Green Dial

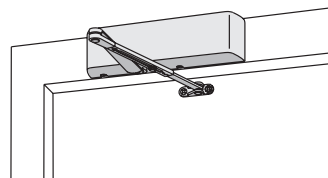
### Available cylinder options

DEL	Delayed action cylinder
-----	-------------------------

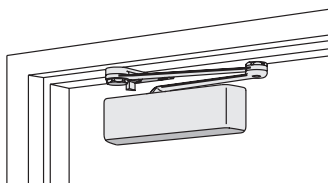
### Mounting



Hinge (pull side)



Top jamb (push side)



Parallel arm (push side)



Surface mounted closer  
4040XP Series

**Finishes**

**Powder coat finishes**



**689** Aluminum  
**690** Statuary Bronze  
**691** Light Bronze  
**693** Black



**695** Dark Bronze  
**696** Brass

150+ additional custom colors available using the RAL numbering system

**Metal plated finishes**



**632** Bright Brass  
**633** Satin Brass  
**639** Satin Bronze  
**616** Satin Bronze, Blackened



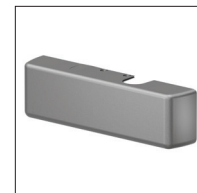
**646** Satin Nickel  
**651** Bright Chrome  
**652** Satin Chrome

**Available finish options**

MTLPC	Brite metallic: Custom powder coat finish, which resembles that of 651 or 652 plated finish.
SRI	For installations where a higher level of protection against weather conditions, or the effects of a potentially corrosive atmosphere is required, LCN offers a special rust inhibiting (SRI) process. Ferrous metal components receive an SRI pretreatment and a standard powder coat finish of your choice, or a custom powder coat finish for a nominal additional cost. Closers treated with the SRI process exceed the 100 hour protection level available with standard LCN powder coated finishes.

**Covers**

**Standard cover**

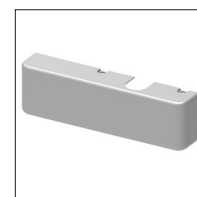


**4040XP-72**

**Plastic cover**

- Non-handed
- Includes 4040XP-54 snap-on cover clip

**Optional cover**



**4040XP-72MC**

**Metal cover**

- Handed
- Required for plated finishes and custom powder coat finishes
- Optional



### Arms



#### 4040XP-3077

##### Regular arm

- Non-handed
- Mounts pull side or top jamb with shallow reveal P4041 closer includes PA SHOE, 4040XP-62PA required for parallel arm mounting



#### 4040XP-3077L

##### Long arm

- Non-handed
- Includes LONG ROD AND SHOE, 4040XP-79LR for top jamb mount
- Optional



#### 4040XP-3077ELR

##### Extra long arm

- Non-handed
- Includes EXTRA LONG ROD AND SHOE, 4040XP-79ELR for top jamb mount with deep reveal
- Optional



#### 4040XP-3049

##### Hold-open arm

- Non-handed
- Mounts pull side or top jamb with shallow reveal, hold-open adjustable shoe
- 4040XP closer includes 4040XP-62PA shoe required for parallel arm mounting
- Optional



#### 4040XP-3049L

##### Long hold-open arm

- Non-handed
- Includes LONG HEAD AND TUBE, 4040XP-3048L for top jamb mount
- Optional



#### 4040XP-3077EDA

##### Extra duty arm

- Non-handed
- Features forged, solid steel main and forearm for potentially abusive installations
- Optional



#### 4040XP-3049EDA

##### Hold-open extra duty arm

- Non-handed
- Parallel arm features forged, solid steel main and forearm for potentially abusive installations
- Hold-open function is adjusted at the shoe
- Optional



#### 4040XP-3077EDA/62G

##### Extra duty arm with 62G

- Non-handed
- Features forged, solid steel main and forearm for potentially abusive installations
- 62G shoe provides additional blade stop clearance
- Optional



#### 4040XP-3049EDA/62G

##### Hold-open extra duty arm with 62G

- Handed
- Features forged, solid steel main and forearm for potentially abusive installations
- 62G shoe provides additional blade stop clearance. Hold-open function is adjusted at the shoe
- Optional



#### 4040XP-3077CNS

##### Cush-N-Stop® Arm

- Non-handed
- Features solid forged steel main arm and forearm with stop in soffit shoe.
- Optional



#### 4040XP-3049CNS

##### HCUSH arm

- Non-handed
- Hold-open function with templated stop/hold-open points
- Handle controls hold-open function
- Optional



#### 4040XP-3077SCNS

##### Spring CUSH arm

- Non-handed
- For potentially abusive applications features solid forged steel main arm and forearm with spring loaded stop in the soffit shoe
- Optional

**Arms**

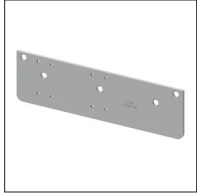


**4040XP-3049SCNS**

**Spring HCUSH arm**

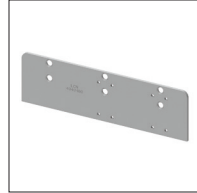
- Non-handed
- For potentially abusive applications features solid forged steel main arm and forearm with spring loaded stop in the soffit shoe
- Handle controls hold-open function
- Optional

## Installation accessories



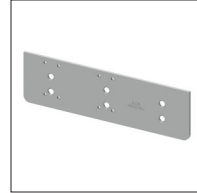
**4040XP-18  
Plate**

- Required for hinge side mount where top rail is less than 3 3/4" (95 mm)
- Requires minimum 2" (51 mm) minimum top rail



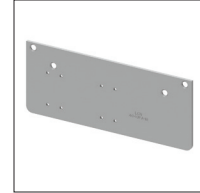
**4040XP-18G  
Plate**

- Locates top jamb mounted closer flush with top of head frame face in flush ceiling condition
- Requires 1 3/4" (44 mm) minimum head frame



**4040XP-18TJ  
Plate**

- Centers top jamb mounted closer vertically on head frame where face is less than 3 1/2" (89 mm). Plate requires 1 3/4" (44 mm) minimum head frame



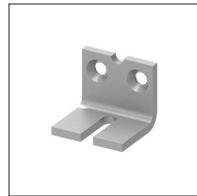
**4040XP-18PA  
Plate**

- Required for parallel arm mounting where top rail is less than 5 1/2" (140 mm), measured from the stop
- Requires 2" (51 mm) minimum top rail



**4040XP-62PA  
PA shoe**

- Required for parallel arm mounting



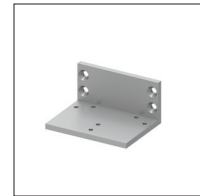
**4040XP-30  
CUSH shoe support**

- Provides anchorage for fifth screw used with CUSH arms, where reveal is less than 3 1/16" (78 mm)
- Optional



**4040XP-61  
Blade stop spacer**

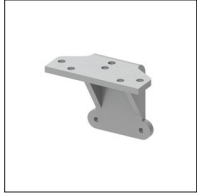
- Required to lower parallel arm shoe to clear 1/2" (13 mm) blade stop
- Optional



**4040XP-419  
PA flush panel adapter**

- Provides horizontal mounting surface for parallel arm shoe on single rabbeted or flush frame
- Optional

### Installation accessories



**4040XP-62A**  
**Auxiliary shoe**

- Requires a top rail of 7" (178 mm)
- Shoe replaces -62PA for parallel arm mounting of regular arm with overhead holder/stop
- Optional



**4040XP-54**  
**Snap-on cover clip**

- Used to secure 4040XP-72 plastic cover to cylinder body

### Fasteners

Self-reaming and tapping screws included standard

#### Fastener pack options

TBSRT	TB <sup>1</sup> with self-reaming and tapping screws
WMS	Wood and machine screw
TBWMS	TB <sup>1</sup> , wood and machine screw
TORX	TORX machine screw
TBTRX	TB <sup>1</sup> and TORX machine screw

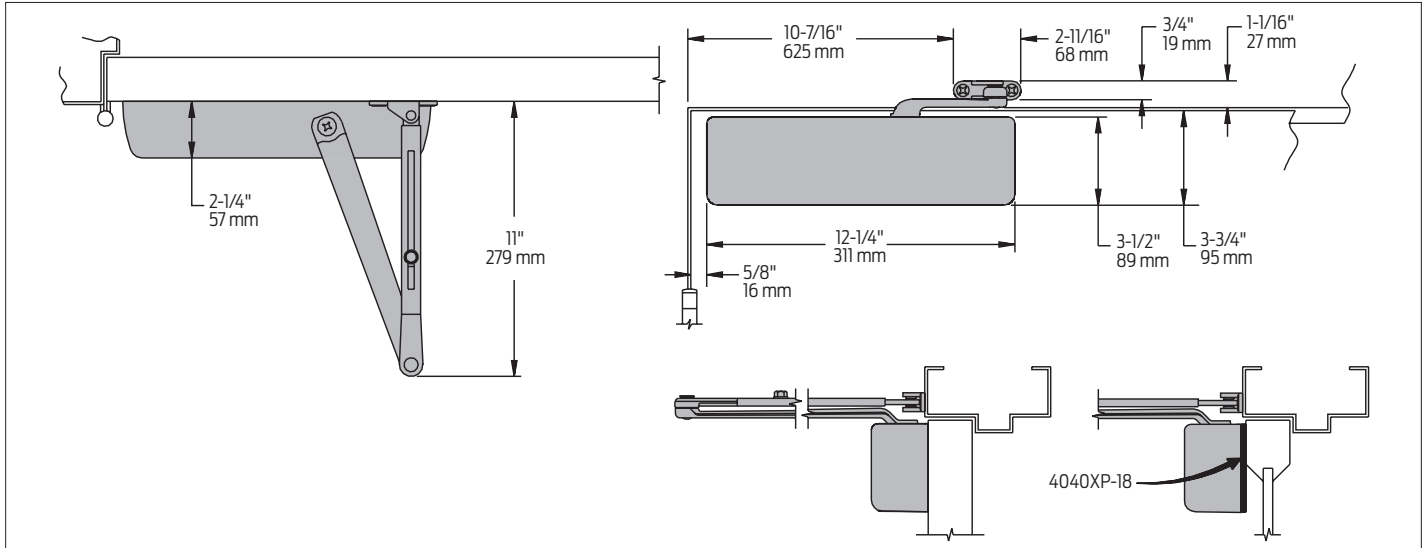
<sup>1</sup> Specify door thickness if other than 1 3/4"



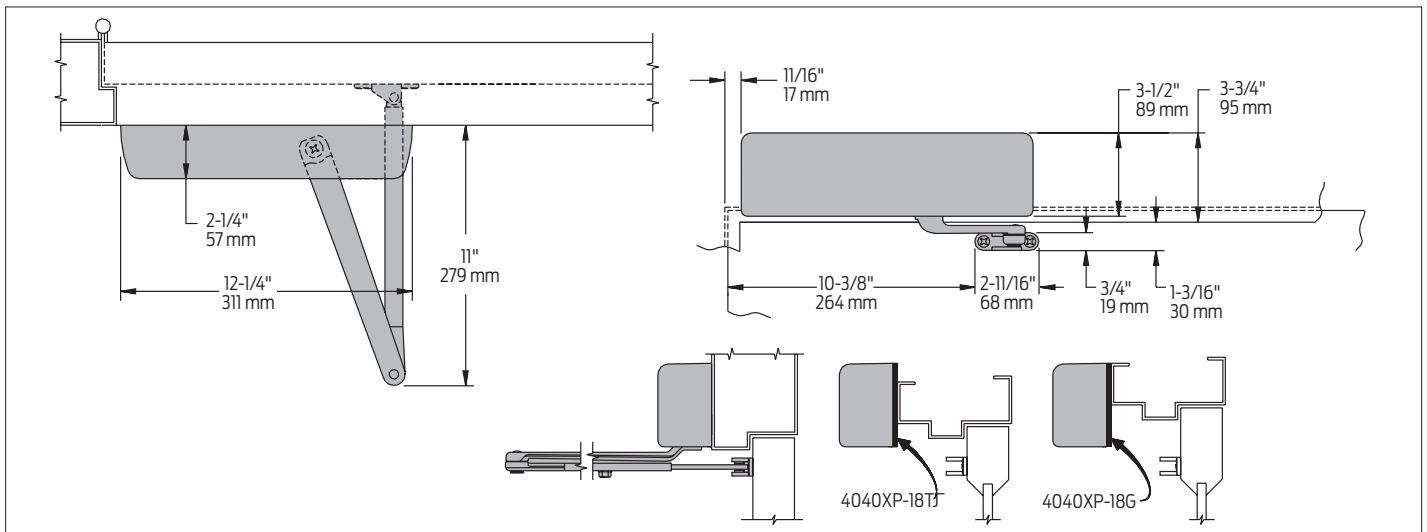
Surface mounted closer  
4040XP Series

Dimensions and mounting

Hinge (pull) side mounting



Top jamb (push side) mounting

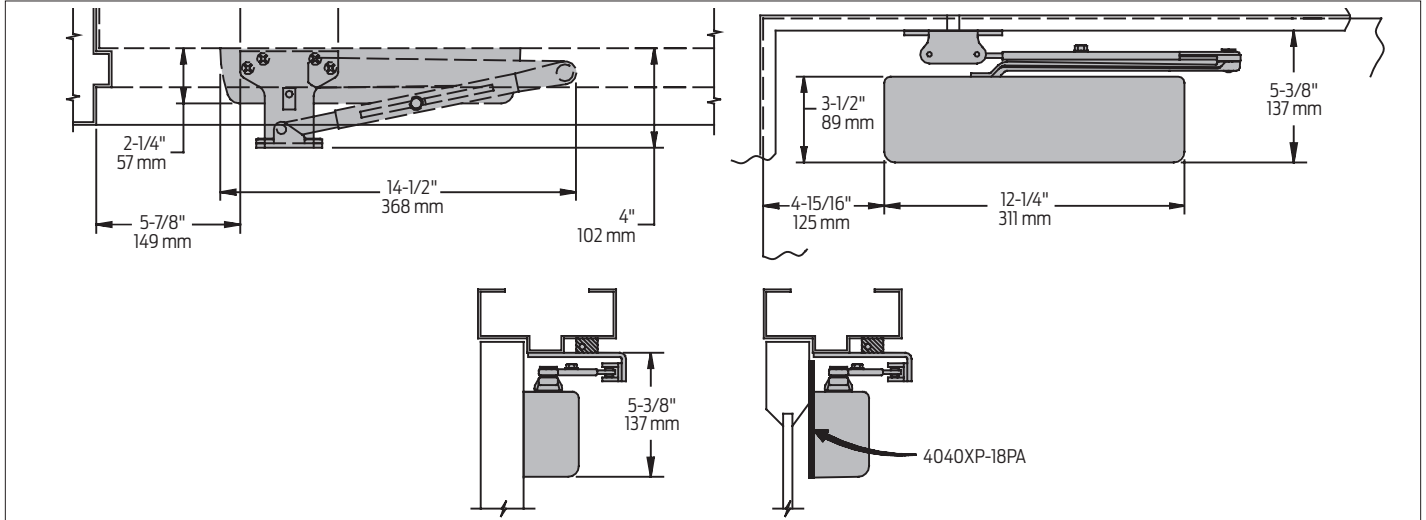




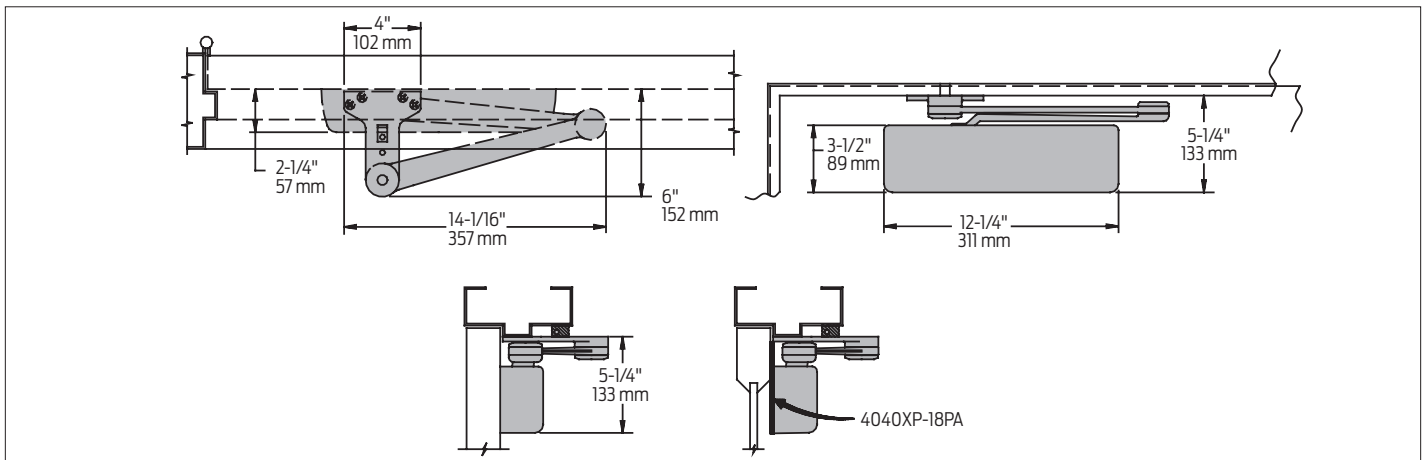
Surface mounted closer  
4040XP Series

Dimensions and mounting

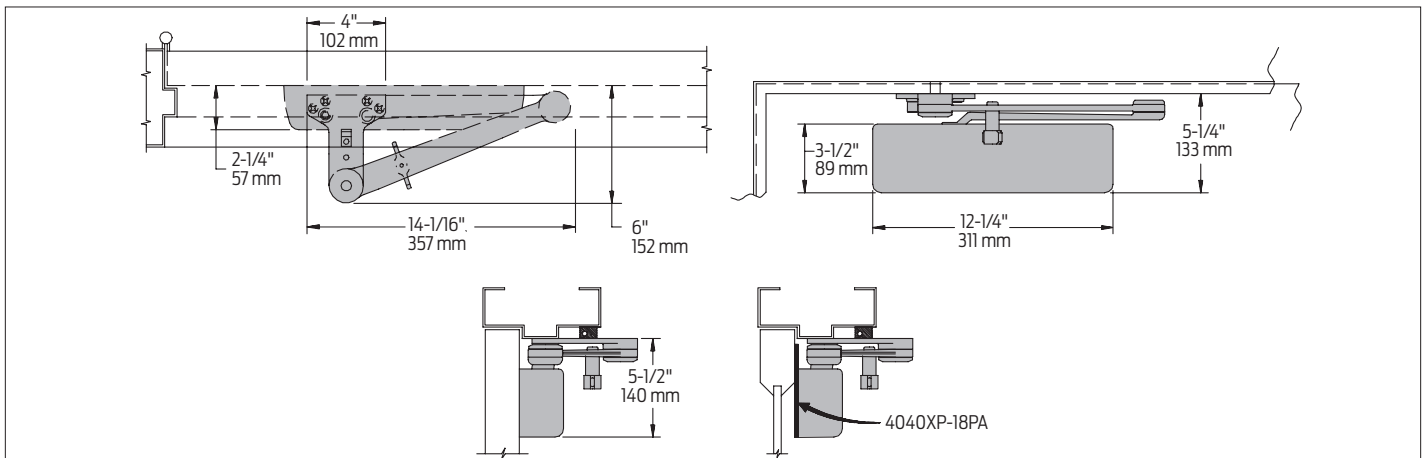
Parallel arm (push side) mounting



EDA mount



CUSH mount





Surface mounted closer  
4040XP Series

### Specifications

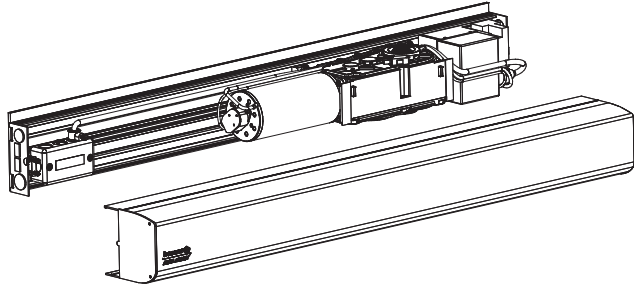
Accessibility	Available with less than 5.0 lbs. opening force on 36" door
Certifications/ approvals	<ul style="list-style-type: none"> <li>■ Grade 1 - ANSI A156.4</li> <li>■ UL 10C</li> <li>■ Meets BAA - Buy American Act</li> </ul>
Degree of operation	<p>Hinge (pull) side</p> <p>Max opening: 120°</p> <p>Hold open: 90-120°</p> <p>Top jamb (push side) mount</p> <p>Max opening: 120°</p> <p>Hold open: 85-120°</p> <p>Parallel arm with 62PA</p> <p>Max opening: 180°</p> <p>Hold open: 180°</p> <p>EDA</p> <p>Max opening: 180°</p> <p>Hold open: 180°</p> <p>Cush and spring cush</p> <p>Max opening: 110°</p> <p>Hold open: 110°</p>
Environmental conditions	<ul style="list-style-type: none"> <li>■ Approved for interior use</li> <li>■ Approved for exterior use (SRI coated only)</li> <li>■ LCN's standard all weather fluid performs to temperature ranges from 120°F (49°C) to -30°F (-35°C)</li> <li>■ LCN's powder coat finish surpasses 100 hours of salt spray which is over four times the ANSI standard for corrosion resistance.</li> </ul>
Warranty	30 years
Standard features	<ul style="list-style-type: none"> <li>■ Cast iron body</li> <li>■ Full complement bearing</li> <li>■ 1 1/2" diameter piston</li> <li>■ 1/16" diameter double heat treated pinion journal</li> </ul>

# SW200i™

**besam**
**ASSA ABLOY**

## Technical Data Sheet

ASSA ABLOY, the global leader  
in door opening solutions



### SW200i Swing Door Operator

The Besam SW200i is the definitive pedestrian swing door operator, performing to the highest standards in the industry. Packed with the most innovative and advanced technological features, the Besam SW200i performs in the most adverse conditions and environments, setting a new level of performance for power door operators.

### Intended Use

The Besam SW200i is an automatic swing door operator suitable for use in exterior or interior entryways and corridors. The Besam SW200i is a universal heavy duty (HD) electro-mechanical operator suitable for use on large heavy doors, yet can also be used in low energy (LE) applications. The product can be either surface mounted or overhead concealed, on either side of the door, for pull or push applications. It is suitable for single doors, double doors and double egress doors fitted with swing clear hinges, offset pivots or center pivots. The operator is connected to the door leaf with a range of different arm systems.

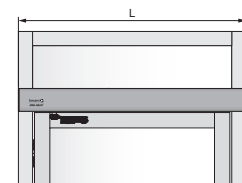
Besam SW200i is designed to offer continuous use, a high degree of safety and maximum performance over the lifetime of your entrance. The Besam SW200i ensures all-around safety and can be equipped with a full range of sensor products providing swing door safety that meets or exceeds ANSI A156.10 standard.

### Operator Features and Performance

- Operator: electro-mechanical, non-handed operator, 24 volt,  $\frac{5}{16}$  hp motor
- ANSI Compliance: Field selectable full pedestrian usage (ANSI A156.10) and low energy (ANSI A156.19)
- Door Weight: up to 700 pounds (315 kg) per operator
- Door Size: up to 48" (consult for wider sizes)
- Manual Push Force: adjustable from 5 lbf – 15 lbf
- Hold Open Time: adjustable from 1.5 seconds to 30 seconds
- Wind Force Dampening: operator mechanically counteracts to wind forces, slowing down the opening or closing of the door
- Stack Pressure Compensation: operator counteracts to positive stack pressures, negative stack pressures, and sudden changes of stack pressures to maintain consistent door speeds
- Intelligent Trajectory Control: operator knows where the door should be at all times and adjusts torque accordingly. Dynamic braking helps cushion the door during opening to prevent going past 90 degrees, or during closing to prevent slamming.



- Extended Closing Torque (ECT): Besam's exclusive Extended Closing Torque (ECT) functionality provides extra torque in the last 10 degrees of closing, if needed, to close and latch the door. Speed remains constant so the door stays within ANSI standards.
- Latch Retry: if the door does not latch when closing, the SW200i will detect this condition and immediately open the door to 10 degrees and execute two attempts to latch the door.
- On-board timing sequencer
- On-board 12V or 24V transformer
- Low pass filter (i.e. "delay on make")
- Door position relay
- Kill input to close doors immediately
- Self-learning set-up – measures inertia and door weight
- Low Power Consumption (300 watts, 2.5 amp (max))

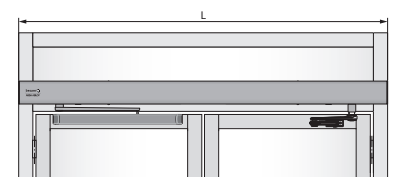
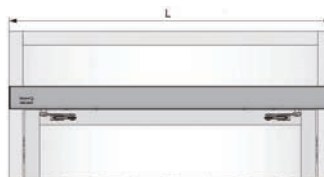


**Door Set-ups:**

**Left: Single**

**Below Left: Simultaneous Pair**

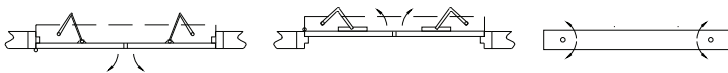
**Below Right: Pair Egress**





## Operation

- Automatic sensor activation (ANSI A156.10)
- Push plate activation (ANSI A156.19 or A156.10)
- Push and go feature allowing door to open automatically when operator senses movement of door (ANSI A156.19)
- Power assist open – provides easy to open push forces (ANSI A156.19)
- Internal, push to open, push to close (i.e., ratchet relay) (ANSI A156.19)
- Speed controlled Extended Closing Torque (ECT) to provide power assist close with on-board functionality to automatically adjust torque without increasing speed
- Loss of Power: the operator controls the door closing, preventing slamming of door
- Torque Limiting: if positive air pressure condition is removed, operator compensates accordingly and will not slam



Door Operator Handlings

## Electric Lock Management

- Lock monitoring prevents operator(s) from opening door(s) until release of electrified lock
- Operator pulls door closed before opening, unjamming electric latch hardware
- Sequenced operation between operators for pairs of doors allowing lock release and astragal coordination
- Electric Lock Output: selectable 12 VDC, maximum 1200 mA / 24 VDC, maximum 600 mA

## Sensor Monitoring

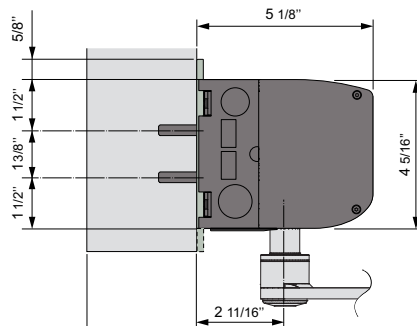
- Monitored Door Mounted Presence Sensors – upon detection of sensor failure, the operator will automatically revert to low energy mode
- Blanking Potentiometer: tells sensors on swing side of door when to shut off
- Sensor Recognition – learn process
- Torque Cancellation – Extended Closing Torque (ECT) is deactivated if signal is received from door mounted presence sensors of a possible obstruction

## Aesthetics

- Aesthetically pleasing, low profile appearance: 4-5/16" (109mm) high by 5-1/8" (130mm) deep
- Continuous header for full width of door
- Same header/housing as Besam PowerSwing and Besam SW100 for consistent sightlines in your facility
- Finishes: anodized, powder coat, Kynar, clad

## Configurations

- Surface Applied
- Overhead Concealed – center pivoted or offset pivoted doors
- Overhead Concealed – with emergency breakaway



## Authorities

- UL/CUL approved
- UL Listed Fire Door Operator
- UL10C, UL325, UL991, UL244A, UL1998, UL1310
- IBC and CBC
- ANSI A156.10 / ANSI A156.19
- CAN/CSA-C22.2 NO 223-M91 and CAN/CSA-C22.2 NO 223-M92
- California State Fire Marshall

## Sensor Packages

- Sensor Packages as follows:

### ANSI A156.19

- Activation: push plates per your selection
- Safety devices: not required per ANSI. Optional door mounted presence sensors (DMPS) are available

### ANSI A156.10

- Activation: push plates per your selection (motion sensors or push plates)
- Choice of Besam i-Adapt™ door mounted presence sensor system:
  - A202 – Besam i-Adapt Premium – stand alone, adapted field, door mounted presence sensors (DMPS)
  - A102 – Besam i-Adapt Flex – overhead presence sensor (OPS) and two door mounted presence sensors (DMPS) per leaf (approach and safety)
  - A101 – Besam i-Adapt Flex - overhead presence sensor (OPS) and one door mounted presence sensors (DMPS) per leaf (safety)
  - A100 – Besam i-Adapt Flex – Knowing Act applications – pair egress only – motion sensor approach and safety side for secondary activation per ANSI A156.10

## Technical Specifications

<b>Operator type</b>	Electro-mechanical
<b>Door width</b>	36" – 48" (914 – 1219mm)
<b>Door weight</b>	100 – 700 lb (45 – 315 kg)
<b>Power supply</b>	120 V AC +10/-15%, 50/60 hz
<b>Power consumption</b>	Max. 300W
<b>Auxiliary voltage</b>	24 V DC, max. 700 mA
<b>Internal control fuse</b>	2 x T 6, 3 AH 250 V
<b>Electro-mechanical locking device</b>	Selectable: 12V DC, max. 1200 mA / 24 V DC, max. 600 mA
<b>Door opening</b>	<b>Push:</b> 80 – 110° with reveal 0 – 12" (0 – 305mm) <b>Pull:</b> 80 – 110° with reveal 0 – 5-1/8" (0 – 130mm) <b>PAS:</b> 80 – 95° (concealed application)
<b>Opening time (0 – 80°)</b>	Variable between 2 – 12 seconds
<b>Closing time (90 – 100°)</b>	Variable between 4 – 12 seconds
<b>Hold open time</b>	1,5-30 seconds
<b>Ambient temperature</b>	-31° F to 160° F (-35° C to 71° C)
<b>Relative humidity</b>	Max. 85%
<b>Drive weight unit (non-condensing)</b>	19.8 lb (9 kg)
This product is to be installed internally or externally with suitable weather protection.	
<b>Class of protection</b>	IP 20.
<b>Complies with:</b> ANSI/BHMA A156.19, ANSI/BHMA A156.10, UL325, UL 991, UL 244A, UL 1998, UL 1310, UL 10C, CAN/CSA-C22.2 NO 223-M91, CAN/CSA-C22.2 NO 247-92 and CA State Fire Marshall	

# INGRESS'R® I36-3

I36-3 (CLEAR)

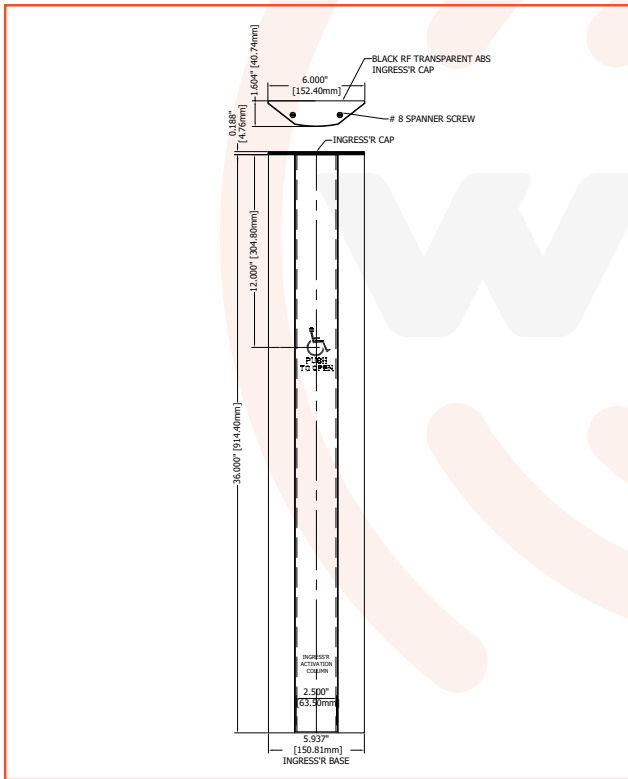
Clear Anodized Aluminum (628)

08 71-02 DOOR HARDWARE page 90 of 110

Phone: 877.421.3158

Fax: 877.421.3158

customerservice@wikk.com



## Specification Summary

The switches to be used throughout the complex shall be Wikk® Industries, Inc. INGRESS'R™ activation door control. The INGRESS'R™ activation door control shall be ADA compliant and exceed California Building Code, Section 11B404.3. INGRESS'R™ shall be such that pressing any part of the actuating column will activate the device. Switches shall be rated at 15A, 125/250VAC; 3/4hp, 125VAC.

### Features:

- Clear Anodized (628) Aluminum Type 6063 T-5
- The contoured profile of The INGRESS'R® allows activation from literally any approach and height level
- Logo is Silk Screened Blue
- The INGRESS'R® is ready for hardwired or wireless products
- Naturally directs movement toward central activation column
- Deflects impact from wheeled carts and conveyances

### Mounting Options:

#### Bollard Mount:

Part# BPS SM INGR: Clear (628), DK Brz (710), LT Brz, Black (711), US32 (629), US32D (630)

Part# BPS SM INGR48: Clear (628), DK Brz (710), LT Brz, Black (711), US32 (629), US32D (630)

Part# 1x6 INGR: Clear (628), DK Brz (710)

#### Wall Mount:

Mounts on most wall surfaces, including uneven surfaces

### Customizable Options:

#### Materials/Finishes:

Dark Bronze Anodized Aluminum (710), Satin Stainless Steel - US32D (630), Mirror Stainless Steel - US32 (629), Mirror Brass (Uncoated) - US3 (605), Satin Brass (Uncoated) - US4 (606),

Oil Rubbed & Relieved Oxidized Brass - US10B (613), Powder Coated - See color Chart

#### Logo:

Logo Silk Screened with colors shown in literature, or custom Logo with your choice of colors: Blue, Black, White, Red, Green, and Chocolate Brown

#### Custom Lengths:

9" (229 mm), 18" (457 mm), 24" (610 mm), 42" (1067 mm)

#### Lights:

Amber, Blue, Red, White, or Yellow - Note: light only illuminates when activated

#### Narrow Style Available (4.25" wide) (-NAR)

#### Double Pole Double Throw (2P)

#### Bottom ABS Cap (CC)

**Overall Dimensions:** 6" Wide x 36" Tall x 1½" Deep  
(125mm x 914mm x 38mm)

Voltage	12/24V AC/DC
Switch Type	Momentary
Contact Type	Single Pole-Double Throw, dry contact momentary action micro-switch, capable of normally open or normally closed operation.
Current Rating	15Amp, 125/250 VAC
Max Temp Rating	-40°F to +221°F (-40°C to +105°C)
	UL & CSA Tested

For technical assistance, contact [engineering@wikk.com](mailto:engineering@wikk.com)

### 8400 Series Protection Plates

- Door protection plates are available in .050" thick brass, stainless steel or aluminum; and 1/8" thick high impact polyethylene in clear or black.
- Bevel edge options; specify B4E for all four edges.
- Mounting screw pack furnished standard, 16 screws per pack. Optional screw packs are available for TEK or TORK screw heads. Refer to the following chart for ordering.
- Specify NMH for no mounting holes. (Not available on 8402)
- Specify NMH-A for no mounting holes with adhesive. (Not available on 8402)
- Specify CS for counter sunk mounting holes.
- Specify ERS prepped with extra row of screws.

**Kickplate Gasket Tape** Tape is recommended when using a brass plate on a metal door to reduce tarnishing from electrolytic oxidation. One tape pack will cover an the perimeters of a 8" x 34" kickplate. Order 8401 Gasket Tape.



#### 8400 Protection Plate 8402 (UL)\* Protection Plate

\*UL mark appears in upper right corner. Factory supplied screws must be used.

Number of screw packs required by plate size (specify TEK Screws or TORK screws).

	22"-25"	26"-33"	34"-41"	42"-48"
4"-8"	1	1	1	1
9"-16"	1	1	1	1
17"-24"	1	1	1	2
25"-32"	1	1	2	2
33"-40"	1	2	2	2
41"-48"	2	2	2	2

#### Finishes brass 24" x 48" max. size

US Number	US3	US4	US10	US10B	US15	US26	US26D
BHMA	605	606	612	613	619	625	626

#### Finishes stainless steel

US Number	US32	US32D
BHMA	629	630

#### Finishes aluminum

US Number	US28
BHMA	628

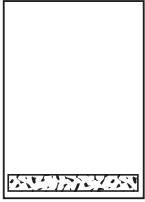
#### Finishes plastic

Clear and Black

Residential Grade Kickplates available Carded only, finishes PA28, PA3, PA619, PA716, B3, B505, B619, B716

A

Hinges &amp; Pivots



### Mop Plates

- Protect the bottom of the pull side of door subject to cleaning and mopping procedures.
- Size Ranges: 4" to 6" high, 22" to 48" wide

B18

Pulls &amp; Plates



### Kick Plates

- Protect the bottom of the push side of doors subject to scuffing from foot traffic.
- Recommended for all doors subject to normal use (especially doors using a closer).
- Size Ranges: 8" to 24" high, 22" to 48" wide

C

Flush Bolts &amp; Coordinators

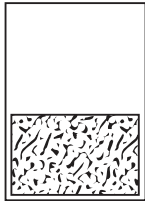


### Stretcher Plates

- Protect doors at specific areas where consistent contact is made by stretchers, service carts or other equipment.
- Usually applied to push side of doors.
- Specify "B4E" Option for beveled edges.
- Size Ranges: 6" to 8" high, 22" to 48" wide

D

Latches, Catches &amp; Bolts



### Armor Plates

- Protect lower half of doors from abuse by hard carts, trucks and rough usage.
- Usually applied to push side of single doors and both sides of double acting doors.
- Size Ranges: 26" to 48" high, 22" to 48" wide

E

Stops

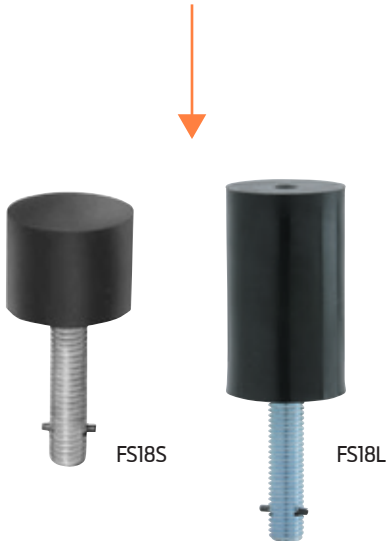
F

Exterior Hardware

G

Miscellaneous Hardware

## Floor Stops

**IVES**<sup>®</sup>**FS18S  
FS18L Floor Stops**

- Security Door Stops designed for use in high vandalism areas.
- Molded from black flame resistant, resilient material around a heavy-duty stud.
- Once grouted in concrete, leaves no exposed fasteners to be tampered with or removed.
- Ideal for jail or security cell areas where floor mounted stops are required.
- FS18L also ideal for concrete wall applications.

**Dimensions**

FS18S Height: 1-1/2"

FS18L Height: 3-1/2"

FS18S Diameter: 2"

FS18L Diameter: 2"

FS18S Stud Length: 2-1/2"

FS18L Stud Length: 2-1/2"

**FS434 Floor Stop**

- Burnished wrought steel.
- For undercut doors up to 1-1/2".
- Packed with screws and plastic anchors.
- Replaceable soft, resilient gray rubber.

**Dimensions**

Overall Height: 2-5/8"

Base Size: 1-1/2" W x 2-3/4" L

**Finishes**

Ives Number	USC
BHMA	604

**430 Floor Door Stop**

- Burnished wrought steel.
- For undercut doors up to 1-1/2".
- Packed with screws and plastic anchors.
- Replaceable soft, resilient gray rubber.

**Dimensions**

Overall Height: 1-5/16"

Base Diameter: 1-1/4"

**Finishes brass**

Ives Number	B3	B4	B5	B10B	B15	B26	B26D
BHMA	605	606	609	613	619	625	626

**Finishes aluminum**

Ives Number	A3*	A5	A14	A92
BHMA	666		669	673

\* only available in Slim-Pak of 25

Hinges & Pivots  
**A**Pulls & Plates  
**B**Flush Bolts & Coordinators  
**C**Latches, Catches & Bolts  
**D****E5**  
StopsExterior Hardware  
**F**Miscellaneous Hardware  
**G**

# Wall Bumpers

# IVES®



WS401CCV & WS402CCV  
Meets ANSI/BHMA 156.16 L12251 for brass

WS401CVX & WS402CVX  
Meets ANSI/BHMA 156.16 L12101 for brass

## WS401CVX Wall Bumpers

### WS401CCV

### WS402CVX

### WS402CCV

- Constructed in heavy-duty cast brass.
- Special retainer cup makes rubber tamper resistant.

WS401CVX (401) – convex rubber bumper, packed with wood screw and plastic anchor.

WS401CCV (401-1/2) – concave rubber bumper which avoids damage to locks with projecting buttons, packed with wood screw and plastic anchor.

WS402CVX (402) – convex rubber bumper packed with screw and drywall anchor.

WS402CCV (402-1/2) – concave rubber bumper which avoids damage to locks with projecting buttons and is packed with screw and drywall anchor.

### Dimensions

Base Diameter: 2-1/2"

Base Thickness: 3/8"

Overall Projection: 1"

### Finishes

Ives Number	US3	US4	US10	US10B	US15	US26	US26D
BHMA	605	606	612	613	619	625	626



## WS404CVX Wall Bumpers

- Compact size.
- Constructed in cast brass.
- Totally concealed mounting discourages vandalism or tampering.
- Unit furnished with grey convex rubber bumper.
- Packed with sheet metal screw, rawl plug and brad.

### Dimensions

Base Diameter: 1"

Overall Projection: 17/32"

### Finishes

Ives Number	US3	US4	US5	US10	US10B	US15	US26	US26D
BHMA	605	606	609	612	613	619	625	626

Hinges & Pivots  
**A**

Pulls & Plates  
**B**

Flush Bolts & Coordinators  
**C**

Latches, Catches & Bolts  
**D**

Stops  
**E11**

Exterior Hardware  
**F**

Miscellaneous Hardware  
**G**

**E11**

# Floor Stops – Dome IVES®



**FS436**  
Meets ANSI/BHMA 156.16, L12141 for brass or bronze and L32141 for aluminum.



**FS438**  
Meets ANSI/BHMA 156.16, L12141 for brass or bronze and L32141 for aluminum.

**FS436 Dome Stop**  
**FS438 Dome Stop**

- FS436 for doors without threshold.
  - FS438 for doors with threshold or undercut doors.
  - Heavy-Duty Cast Dome Stops constructed of brass, bronze or aluminum.
  - Packed with wood screw and plastic anchor.
- Replaceable gray, non-marring rubber bumper.

**Dimensions**

**FS436**

Overall Height: 1"  
Base Height: 3/16"  
Base Diameter: 1-3/4" x 2" Oval

**FS438**

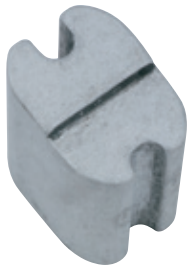
Overall Height: 1-3/8"  
Base Height: 9/16"  
Base Diameter: 1-3/4" x 2" Oval

**Finishes brass**

Ives Number	US3	US4	US5	US10	US10B	US15	US26	US26D	B716
BHMA	605	606	609	612	613	619	625	626	

**Finishes aluminum**

Ives Number	US28
BHMA	628

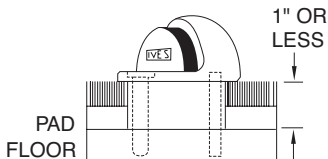
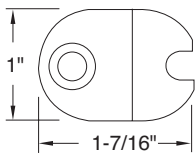


**R435 Riser for FS436 Dome Stop**  
**R437 Riser for FS438 Dome Stop**

- Extruded aluminum, mill finish.
- R435 for conversion of FS436 Dome Stop to carpet installation.
- R437 For conversion of FS438 Dome Stop to carpet installation.
- Packed with wood screws, lead shield and stud. Specify Tampin (TPN) if required.

**Dimensions**

Available in 1/4", 3/8", 1/2", 5/8", 3/4" and 1" height.



A  
Hinges & Pivots

B  
Pulls & Plates

C  
Flush Bolts & Coordinators

D  
Latches, Catches & Bolts

E3  
Stops

F  
Exterior Hardware

G  
Miscellaneous Hardware



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 Tel 1-877-671-7011 ■ Fax 800-851-0000  
 Zero.Customer.Support@allegion.com  
 www.zerointernational.com

Part No:

142 Rain drip

Part description:

Accessories &amp; options

Notes:

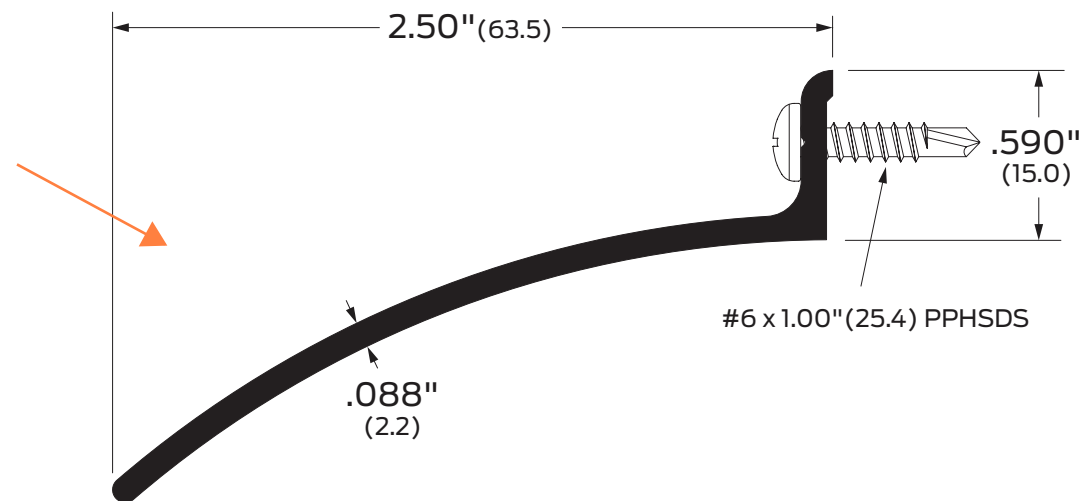
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Customer name:

Job no:

Date:

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## Certifications:

Fire rated-UL10c

## ANSI/BHMA:

142AA, 142BK, 142D, 142G

R3Y976

## Finishes:

**AA** Aluminum clear anodized  
**BK** Aluminum black anodized  
**D** Aluminum dark bronze anodized  
**G** Aluminum gold anodized

## Options:

**SEC** Security screws





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Part No:

328

Part description:

Head & jamb gasketing,  
 door sweep, meeting stile

Notes:

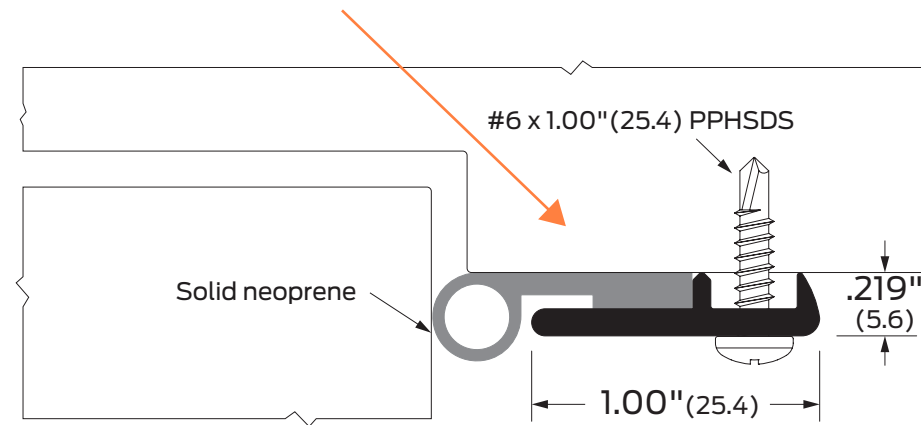
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Customer name:

Job no:

Date:





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## Notes:

ZAG option for mental health applications includes security screws

## Certifications:

-  Fire rated-UL10c
-  Smoke and draft control (as head & jamb, door sweep)
-  Air Infiltration (as head & jamb)
-  Sound

## ANSI/BHMA:

328AA, 328BK,  
 328D, 328G      R3B164, R3B434, R3B735  
 328B              R1B164, R3B434



## Finishes:

**AA** Aluminum clear anodized  
**BK** Aluminum black anodized  
**D** Aluminum dark bronze anodized  
**G** Aluminum gold anodized  
**B** Bronze, architectural mill finish  
**B-ORB** Oil-rubbed bronze

## Options:

**ZAG** Ligature resistant gasketing  
**S** Order as a set  
**SEC** Security screws



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Part No:

429

Part description:

Head &amp; jamb gasketing

Notes:

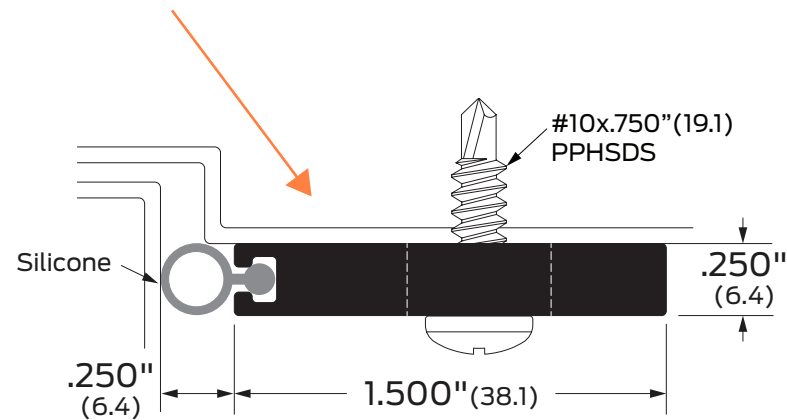
Provided by:

Customer name:

Job no:

Date:

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## Notes:

Gasketing protection for closer bracket or door coordinator.

## Certifications:

- Fire rated-UL10c
- Smoke and draft control

## ANSI/BHMA:

429AA, 429BK, 429D, 429G

R3E164

## Finishes:

- AA** Aluminum clear anodized
- BK** Aluminum black anodized
- D** Aluminum dark bronze anodized
- G** Aluminum gold anodized

## Options:

- S** Order as a set
- SEC** Security screws





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Part No:

488S

Part description:

Self-adhesive weatherstripping

Notes:

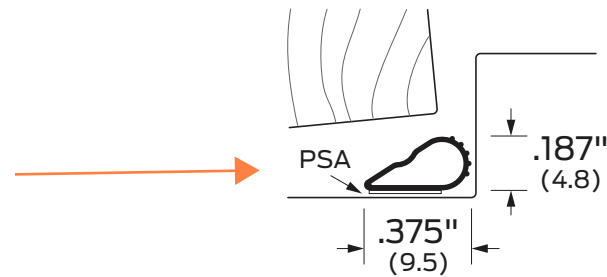
Provided by:

Customer name:

Job no:

Date:



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## Notes:

PSA standard.

## Certifications:

-  Fire rated-UL10c
-  Smoke and draft control

## ANSI/BHMA:

488S

R0E154

## Finishes:

- BK** Black
- BR** Brown
- CL** Clear
- GY** Gray
- WH** White

## Options:

- ZAG** Ligature resistant gasketing





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Part No:

369

Part description:

Automatic door bottom  
 Heavy duty

Notes:

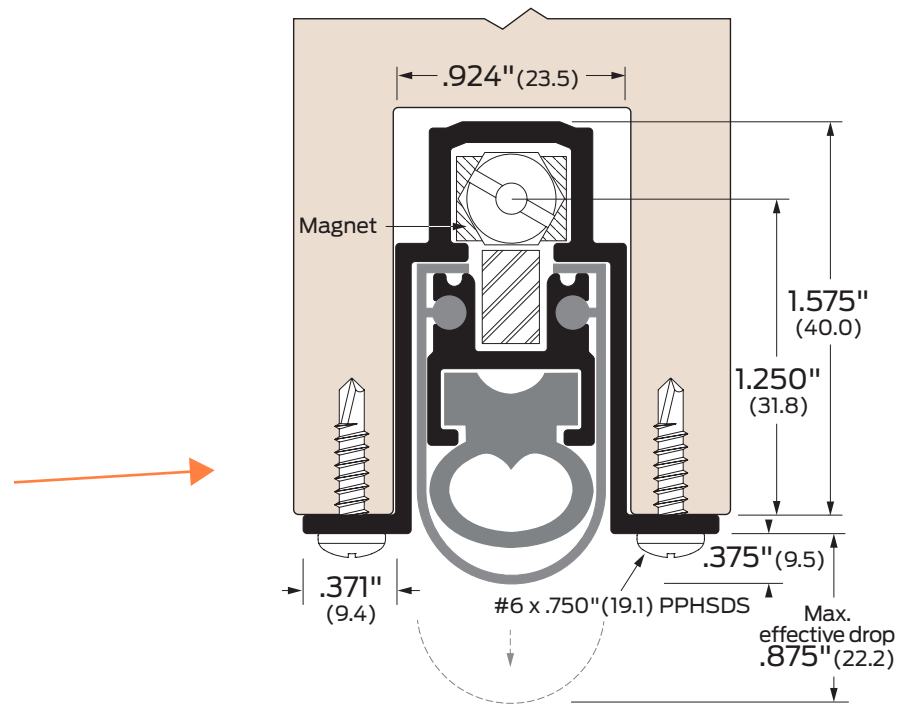
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Customer name:

Job no:

Date:

Image may not be shown to scale



## Notes:

Mortised. Supplied with double solid neoprene seal.  
 Magnet feature only on ADBs 24" and over.  
 Consult your local AHJ for maximum allowable door undercut.

## Certifications:

Fire rated-UL10c  
 Sound

## ANSI/BHMA:

369AA

R3B3241

## Finishes:

AA Aluminum clear anodized

## Options:

**Z49** Removable end cap  
**PL** Pull out  
**NH** No holes





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Part No:

39

Part description:

Door sweep

Notes:

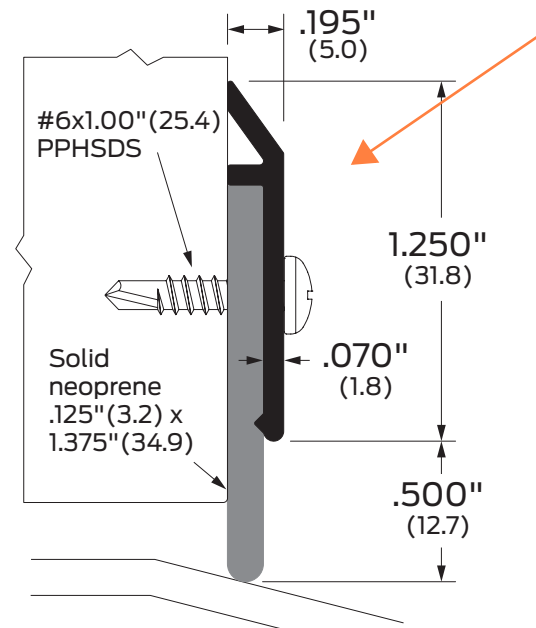
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Customer name:

Job no:

Date:

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## Certifications:



Fire rated-UL10c

## ANSI/BHMA:

39A, 39BK, 39D, 39G

R3B434

## Finishes:

- A** Aluminum mill finish
- BK** Aluminum black anodized
- D** Aluminum dark bronze anodized
- G** Aluminum gold anodized

## Options:

- S** Order as a set
- SEC** Security screws





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Part No:

44

Part description:

Meeting stile

Notes:

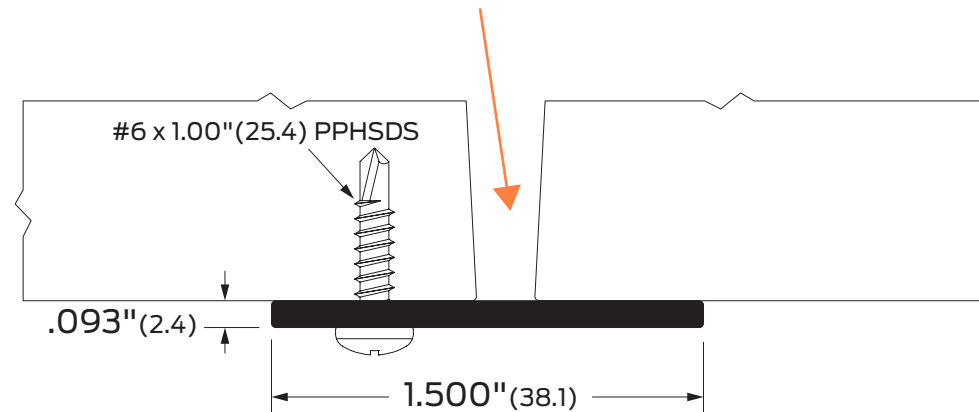
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Customer name:

Job no:

Date:

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Notes:

Stainless steel finish only.

ANSI/BHMA:

44STST

R5Y636

Finishes:

**STST** Stainless steel

Options:

**SEC** Security screws



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Part No:

102

Part description:

Offset threshold

Notes:

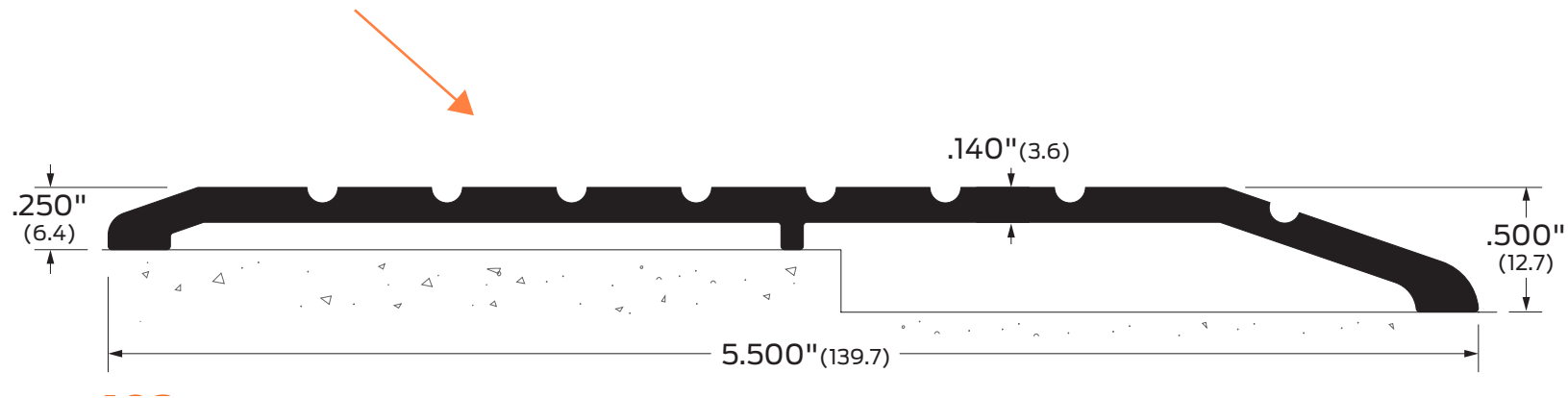
Provided by:

Customer name:

Job no:

Date:



Image may not be shown to scale



## Notes:

Handicap offset. Supplied without mounting holes.

## Certifications:

-  Fire rated-UL10c
-  ADA Accessible

## ANSI/BHMA:

102A, 102D, 102G, 102BK  
 102A-E, 102D-E, 102G-E, 102BK-E

J32180  
 J32280

## Finishes:

- A** Aluminum mill finish
- BK** Aluminum black anodized
- D** Aluminum dark bronze anodized
- G** Aluminum gold anodized

## Options:

- E** Epoxy abrasive tread
- EL** Photoluminescent and abrasive epoxy tread





Meets ANSI/BHMA 156.16, L03011.



Meets ANSI/BHMA 156.16, L03021



### SR64 Door Silencer

- For use on metal frames featuring pneumatic design that, once installed, forms an air pocket to absorb shock and reduce noise of door closing.
- Tamper-proof once installed on the frame.
- Proper installation also eliminates door rattle and provides constant tension for door latches or locks.

Packed in bags of 100.  
Grey Available in bulk pack of 2500.  
Each bag has an installation tool included.

#### Dimensions

Diameter: 1/2"

Thickness: 1/8"

#### Finishes

GRY, TAN

### SR65 Door Silencer

- For use on wood frames, also feature pneumatic design to cushion shock and absorb noise.
- To prevent removal, a small brad should be driven into stop strip and through stem of silencer, as shown in the detail.

Packed in bags of 100.

#### Dimensions

Height: 3/4"

Diameter: 3/8"

Thickness: 1/8"

#### Finishes

GRY

### SR66 Door Silencer

- Self Adhesive Rubber Silencers.
- Economical installation requires no drilling of frames.

Packed two sheets of 50 (100 minimum).

#### Dimensions

Diameter: 1/2"

Thickness: 1/8"

#### Finishes

BRN, GRY, WHT

Hinges & Pivots  
**A**

Pulls & Plates  
**B**

Flush Bolts & Coordinators  
**C**

Latches, Catches & Bolts  
**D**

**E23**  
Stops

Exterior Hardware  
**F**

Miscellaneous Hardware  
**G**





## Mobile enabled multi-technology readers



### Overview

The Schlage® mobile enabled multi-technology readers are designed to simplify your access control solutions and eases the transition from an existing proximity system to a secure encrypted card technology or mobile solution at your own pace—without having to change readers. Three available models fit any need and operate with multiple credential form factors including wristbands, cards, fobs and tags.

- MTB11: Mullion mount mobile enabled multi-technology reader
- MTB15: Single gang mount mobile enabled multi-technology reader
- MTKB15: Single gang mount mobile enabled multi-technology with keypad reader

Schlage mobile enabled multi-technology readers are designed to provide flexible options for making the move to secure mobile credentials at your own pace. Our contactless readers provide both a modern look and an advanced feature set. Designed with technology to support Bluetooth, NFC (Near Field Communication), smart credentials (13.56 MHz) and standard proximity credentials (125 kHz) end users have the ability to define their migration path to secure credentials.

### Features and benefits

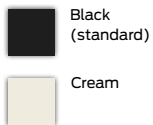
Each Schlage mobile enabled, multi-technology reader contains 125 kHz proximity, 13.56 MHz smart and 2.4 GHz Bluetooth circuitry enabling the ability to process multiple formats simultaneously. Wiegand, Clock & Data, and RS-485 outputs come standard for simple interface with most access control panels.

- Compatible with Bluetooth and NFC-open smart phones
- Clock & Data, Wiegand and RS-485 outputs standard
- Plug & Play mode for straight out of the box functionality
- Commission via ENGAGE™ mobile app for reader updates and easy configuration.
- Improved voltage range of 5V to 28V for simplified power management
- Accommodates interior, exterior, metal and non-metal installation environments
- Improved quick-connect cable allows for easy installation
- Easy-to-install mounting bracket
- Available finishes include: Black (standard) and cream



Model	MTB11	MTB15	MTKB15
Reader type	Mobile enabled multi-technology	Mobile enabled multi-technology	Mobile enabled multi-technology with keypad
Mounting style	Mullion	Single gang	Single gang
Standards	ISO 14443A, ISO 15693		
Certifications	FCC Certification - IC Certification - UL 294/cUL Listed - RED Directive - CE Mark - IP65 - REACH - Bluetooth SIG - RoHS 3		
Frequency	2.4 GHz, 13.56 MHz and 125 kHz		
FIPS 201 compliant	No		
Technology supported			
CSN <sup>1</sup>	✓	✓	✓
Proximity <sup>2</sup>	✓	✓	✓
Smart <sup>3</sup>	✓	✓	✓
Mobile (NFC) <sup>4</sup>	✓	✓	✓
Mobile (Bluetooth) <sup>4</sup>	✓	✓	✓
Read range (Based on ISO Card form factor)			
Prox FSK	Up to 2.25" (5.7 cm)	Up to 4.5" (11.4 cm)	Up to 4.5" (11.4 cm)
Prox ASK	Up to 2.0" (5.1 cm)	Up to 3.75" (9.5 cm)	Up to 3.75" (9.5 cm)
MIFARE Classic® EV1	Up to 2" (5.1 cm)	Up to 2.25" (5.7 cm)	Up to 2.25" (5.7 cm)
MIFARE Plus®	Up to 1" (2.5 cm)	Up to 1.5" (3.8 cm)	Up to 1.5" (3.8 cm)
MIFARE® DESFire® EV1	Up to 1.25" (3.2 cm)	Up to 1.75" (4.4 cm)	Up to 1.75" (4.4 cm)
MIFARE® DESFire® EV2	Up to 2" (5.1 cm)	Up to 2.25" (5.7 cm)	Up to 2.25" (5.7 cm)
Schlage Mobile Credential (Bluetooth) (short range-standard)	Up to 5' (1.5 m)	Up to 5' (1.5 m)	Up to 5' (1.5 m)
Schlage Mobile Credential (Bluetooth) (long range-optional)	Up to 30' (9.1 m)	Up to 30' (9.1 m)	Up to 30' (9.1 m)
System interface	Wiegand / Clock & Data / RS-485 (OSDP, OSDP Secure)		
Voltage range	5-28 VDC		
Current requirements	80mA Average (190mA Peak) @12V 45mA Average (100mA Peak) @24V	80mA Average (190mA Peak) @12V 45mA Average (100mA Peak) @24V	80mA Average (200mA Peak) @12V 45mA Average (105mA Peak) @24V
Pigtail specification	22 AWG, 12 conductor, 12" length		
Tamper	Yes		
Physical dimensions	5.91" x 1.72" x 0.81" 15 cm x 4.4 cm x 2.1 cm	5.1" x 3.25" x 0.76" 12.9 cm x 8.3 cm x 1.9 cm	5.1" x 3.25" x 0.76" 12.9 cm x 8.3 cm x 1.9 cm
Operating temperatures	-40° to 158° F (-40° to 70° C)		
Weight	3.8 oz	6.0 oz	6.1 oz

Color options



- 1 DESFire® CSN, HID iCLASS® CSN, Inside Contactless PicoTag® CSN, ST Microelectronics® CSN, Texas Instruments Tag-It® CSN, Phillips I-Code® CSN
- 2 Schlage® Proximity, HID® Proximity, GE/CASI® Proximity, AWID® Proximity, LenelProx®
- 3 Schlage smart cards using MIFARE Classic® EV1, Schlage smart cards using MIFARE Plus®, Schlage smart cards using MIFARE® DESFire® EV1, Schlage smart cards using MIFARE® DESFire® EV2
- 4 Compatible with Bluetooth and NFC-enabled smartphones

About Allegion

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# Door position switches



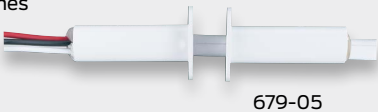
674-OH  
Overhead door, floor mount magnetic switch

## Overview

Door position switches are used to detect the open or closed status of an opening and then send this status to a control panel. They come in a variety of shapes and sizes and are designed for monitoring door positions, roof hatches, gates etc.

### Concealed SPDT magnetic switches

- For wood doors and frames
- 0.3 Amps @ 30 VDC
- UL10C/CAN-ULC-S104



679-05

### Concealed/flush mount magnetic switches

- For aluminum, wood and hollow metal doors
- 0.25 Amps @ 30 VDC
- UL10C/CAN-ULC-S104



7764

- For hollow metal doors and frames
- 0.3 Amps @ 30 VDC
- UL10C/CAN-ULC-S104



679-05HM

### Surface mount magnetic switches

- For aluminum, wood and hollow metal doors
- 0.25 Amps @ 30 VDC
- UL10C/CAN-ULC-S104



7766

- For wood doors and metal frames
- 0.3 Amps @ 30 VDC
- UL10C/CAN-ULC-S104



679-05WD

## Ordering information

- **674-OH** - Overhead door floor mount
- **679-05** - Wood door and frame
- **679-05HM** - Hollow metal door and frame
- **679-05WD** - Wood door and metal frame
- **7764** - Concealed/flush mount
- **7766** - Surface mount

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# PS902

## 2 amp power supply

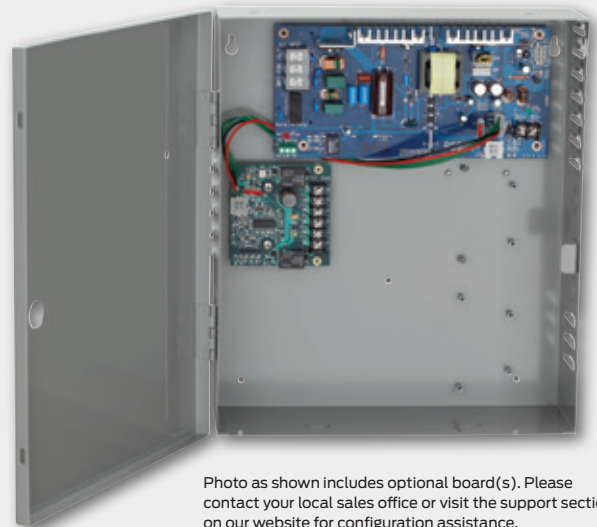


Photo as shown includes optional board(s). Please contact your local sales office or visit the support section on our website for configuration assistance.

## Overview

The Schlage comprehensive line of power supplies and option boards was designed to address the changing needs of the access control market.

Installation is simplified by utilizing a flat mounting design and polarized locking connectors for option boards. This design eliminates the need for racks and side connectors. The flat mounting of the option boards also provides for easier access to the terminal blocks for connection of electrified devices (such as electrified strikes, electromagnetic locks, card readers, etc.).

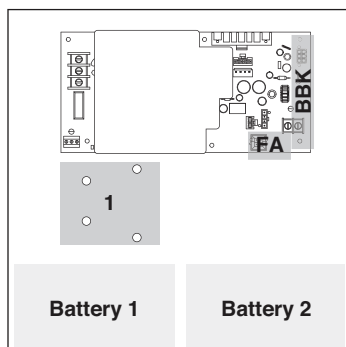
Common to the line of PS900 Series power supplies is a constant output rating at both 12v and 24v settings, universal 120 VAC to 240 VAC input, and polarized option board connectors. New fire alarm interface board mounting allows outputs to be configured as switched (power cut) or unswitched (power continues) when signal is provided.

## Features and benefits

- 2A @ 12/24 VDC constant output, field selectable with jumper
- Provides low-voltage, Class 2, filtered and regulated power
- Universal 120-240 VAC, fused primary input
- Single polarized option board connector
- AC input and DC output monitoring circuit with LED indicators
- Externally visible AC input indicator with isolated SPDT contacts
- High-voltage protective cover for AC circuitry (not shown)
- Battery back-up board auto-selects voltage
- Optional Fire Alarm plug-in board available
- UL 294, ULC-S318, RoHS, and FCC Part 15 certified

## Configuration options

Available option board, fire alarm and battery backup connection locations:



### Exit device support

Von Duprin QEL	Up to 2 <sup>1</sup>
Von Duprin EL	None
Falcon EL	None

1. Requires the use of one 900-2RS option board

## PS902 power supply specifications

Specification	Description
Input voltage	120/240 VAC, 50/60 Hz, universal input
Output voltage	2A @ 12 or 24 VDC Field selectable with jumper Switching supply, 5% regulation, 240mVpp max ripple
Enclosure	Grey/baked enamel 14" x 12" x 4" (H x W x D) Eight 1/2" x 3/4" knockouts NEMA Grade 1 Hinged cover with lock down screws
Operating temperature	32° - 120°F (0° - 49°C)
Certifications	ANSI/UL 294 ULC-S318 RoHS FCC Part 15 Class 2
Battery backup (install on main board)	900-BB: Battery backup board only 900-BBK: Battery backup kit (backup board plus battery pack)
Available option boards	900-FA: Plug-in fire alarm (install on main or option board) 900-2RS: 2 Relay option board capable of individual or sequential operation for single and pair door applications 900-4R: 4 Relay option board 900-4RL: 4 Relay option board with integrated logic and individual or sequential operation capability for controlling security interlocks, auto operators, and time delay function 900-8F: Fused, 8 zone option board 900-8P: PTC, 8 zone option board
AC primary fuse size	3.15A, 250v, 5 x 20mm
Battery fuse size	7.5A 32v ATO blade style
DC output protection	Overload protection - current limited foldback circuit
Indicators	LED indicators: - AC input (visible on outside of enclosure) - DC output Isolated SPDT contacts to monitor AC power status
Weight (power supply)	Approx. 9.0 lbs
Weight (each battery)	4.0 lbs
AC input termination	3 position terminal block with protective cover Wire capacity: 10 AWG max.
DC output termination	2 position terminal block Wire capacity: 12 AWG max.
Option board connectors	1
Fire alarm board connector	Yes
Keylock	Optional
Accessories	900-BAT: Backup battery pack

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## **SECTION 08 71 05 – ACOUSTICAL DOOR GASKETS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section. Requirements: Provide acoustical insulation, sealants and moldable putty pads in accordance with Contract Documents

#### **1.2 SUMMARY**

- A. Furnish and install acoustical door gaskets on building standard doors.
- B. Related Sections. The following work is specified elsewhere:
  - 1. Metal and wood doors.
  - 2. Door frames.
  - 3. Glazing

#### **1.3 SUBMITTALS**

- A. Compliance: Comply with pertinent provisions of Division 1 – General Requirements.
- B. Specifications: Submit Manufacturer's specifications and other product data needed to prove compliance with all specified requirements. Product data shall include: installation instructions, details of construction, materials, dimensions, hardware preparation, acoustical door gaskets, profiles and finishes
- C. Exceptions: Identify all proposed changes, differences, discrepancies and conflicts, including verbiage, terms, definitions between Contract Documents and submittals.

#### **1.4 QUALITY ASSURANCE**

- A. Manufacturer's Experience: The Manufacturer shall have successful experience in fabrication, including no less than five years' experience in the fabrication of materials and products identical to those required in this project.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Comply with pertinent provisions of Division 1 – General Requirements.
- B. Protect products during transit, storage and handling to prevent damage, soiling and deterioration. Comply with the requirements of the manufacturer's instructions for storage and handling.

- C. Identify each product with individual room number which corresponds with designation system used on shop drawings using temporary, removable or concealed markings.

## **PART 2 - PRODUCTS**

### **2.1 DOOR SEAL GROUP DR-1/DR-2**

- A. Fixed head and jamb gaskets shall consist of double row of self-adhesive compression bulb gaskets along the entire length of the head and jamb.
1. National Guard 5050
  2. Pemko S88
  3. Reese 797
- B. Automatic door bottoms shall consist of an extruded aluminum housing with solid neoprene gasket, which is adjusted via adjusting screws. Solid neoprene shall be used to seal the openings between the aluminum housing and the inner solid neoprene gasket assembly. The solid neoprene gasket shall be adjusted to form a uniform compressed seal against a flat, solid floor surface, such as concrete or a flat metal plate. Do not seal automatic door bottom gasket to carpet.
1. National Guard 423N (mortise) / 420N (surface mounted)
  2. Pemko 434A (mortise) / 420A (mortise, alternate for hollow metal doors)
  3. Reese 371 (mortise) / 521 (surface mounted)
  4. Ultra DB 043 (mortise)
  5. Zero International 369 (mortise) / 367 (surface mounted)
- C. Astragal Seals.
1. National Guard 109N
  2. Pemko 355CS
  3. Zero International 1840
- D. Thresholds shall be 0.25-inch tall.
1. Zero International 544
  2. or approved equal.

### **2.2 DOOR SEAL GROUP DR-1A**

- A. Fixed head and jamb gaskets shall consist of single row of self-adhesive compression bulb gaskets along the entire length of the head and jamb.
1. Pemko S88
  2. Reese 797
- B. Astragal Seals.



1. National Guard 178
2. Pemko 355CS
3. Zero International 1840

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install acoustical gaskets in full compliance with the manufacturers printed instructions and recommendations.
- B. Acoustically gasketed doors with door frames (head and jamb) in gypsum board construction shall be fully packed with with 1.5-pcf density unfaced fiberglass or mineral wool insulation. Acoustically gasketed doors with door frames in masonry construction shall be fully grouted.
- C. Inspect adjacent construction and make sure that conditions detrimental to the proper and timely execution of this work are corrected before proceeding with installation.
- D. All seals should be continuous with no interference from door hardware such as closures, exit devices, panic bars, etc. Coordinate auto closer with head gasket, lockset with jamb or meeting stile gasket, knob or pull with jamb and meeting stile gasket, and latches with head and bottom gaskets. Do not cut head or jamb gaskets to accommodate auto closer or other hardware.
- E. Adjust all gaskets to provide airtight seals with no visible gaps or spaces. No light leaks shall be visible at the gasket seals around the entire perimeter of the door. Once properly adjusted, the acoustical door gaskets shall provide a firm uniform compression seal around the perimeters of the doors such that it shall be difficult to slide a credit card between the gaskets and the door leafs. The gaskets shall be adjusted until it is difficult to slide a credit card between the gaskets and door leaf.

#### **3.2 CLEANING**

- A. Clean all surfaces following installation.
- B. Replace material having scratches, abrasions or other defects with unblemished acoustical surface finish assemblies at no cost to the owner.

#### **3.3 PROTECTION**

- A. Protection of acoustical door gaskets and doors from damage by other trades after installation shall be provided by the General Contractor.

**END OF SECTION 08 71 05**

**Waveguide LLC**  
005.2882.000

January 10, 2022  
DSA Back Check

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

## **SECTION 08 80 00 - GLAZING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
  - 1. Doors.
  - 2. Glazed window walls.
  - 3. Glazed entrances.
  - 4. Interior borrowed lites.
  - 5. Storefront framing.
  
- B. Related Requirements:
  - 1. Refer to Section 08 44 13.13 "Glazed Aluminum Window Walls," for requirements applicable to single subcontract responsibility for glazing.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: Submit product data for each glass product and glazing material indicated.
  
- B. Samples: Label samples to indicate product, characteristics, and locations in the Work. Furnish samples of the following:
  - 1. Except for clear glass, submit samples of each glass type specified, in the form of 12 inch square Samples.
  - 2. Submit samples of each glass type specified where production run variations and defects are expected.
  - 3. Furnish 12 inch square glass samples with break-out window indicators applied thereon.

#### **1.3 INFORMATIONAL SUBMITTALS**

- A. Manufacturer Certificates: Submit a letter from glass manufacturer certifying that he has reviewed the glazing details proposed for the Project, including the use of gaskets and sealants, and that each product to be furnished is recommended for the application shown.
  
- B. Design Data: Submit the following from the glass manufacturer:

1. Thermal Stress Analysis: For each exterior glass unit type, each building elevation. The analysis shall clearly indicate all the expected service temperature ranges and the effects of partial and full shading on the glass. Append to the thermal stress analysis a statement from the glass manufacturer that based upon this analysis that the resulting thermal stresses will not reduce the specified "statistical probability of breakage."
  2. Wind Load Analysis: For each glass unit type, each building elevation. The analysis shall clearly indicate that the statistical probability of breakage at the design wind pressure will not exceed the specified statistical probability of breakage.
- C. Product Test Reports: Submit product test reports for each type of glazing sealant and gasket indicated.
- D. Warranties: Submit special warranties specified in this Section.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations for Glass and Glazing Accessories: Obtain glass and glazing accessories from one source for each product indicated below:
1. Primary glass.
  2. Coated glass.
  3. Heat-treated glass, including heat-strengthened, tempered, and heat-soaked glass.
  4. Insulating glass.
  5. Glazing gaskets.
- C. Fire-Rated Window Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.
- D. Safety Glass: Comply with the applicable requirements of the laws, codes, ordinances and regulations of Federal and Municipal authorities having jurisdiction. Wherever requirements conflict, the more stringent shall be required. Obtain approvals from all such authorities. As a minimum, provide Category II materials complying with testing requirements in 16 CFR 1201 (Consumer Product Safety Commission "Safety Standard for Architectural Glazing Materials," as published in the Code of Federal Regulations) and ANSI Z97.1 for Category A performance.
1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction. Locate permanent markings in one corner, and in the same location, of each glass lite in accordance with the requirements of the SGCC labeling guidelines. Markings shall have a nominal size of no greater than 1-inch in diameter, and be located with glass edge clearances, at the corner, by not more than 3/4-inch up and 3/4-inch over.

- E. 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. GANA Publications: GANA's "Glazing Manual" and "Laminated Glass Design Guide."
  2. IGMA Publications: IGMA TM-3000, "Vertical Glazing Guidelines."
- F. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the Insulating Glass Certification Council (IGCC) or of the Associated Laboratories, Inc. (ALI).
- G. Sample Installations: Refer to Section 08 44 13.13 "Glazed Aluminum Window Walls" for requirements applicable to sample installations.
1. Representatives of glass and glazing materials manufacturers, together with Contractor's field supervisor for glazing, shall be present during construction and field testing (if any) of sample installations.
  2. Prepare sample installations where shown and as required to match approved shop drawings and the Contract Documents in all respects before proceeding with the Work.
  3. Accepted sample installations may remain as a portion of the completed Work.
- H. Pre-Construction Testing:
1. Bow and Warp Distortion (Flatness) Tolerance Testing:
    - a. Prior to the visual observation by the Architect and Owner of the preconstruction glass mockups, measure each mockup lite for bow and warp in accordance with ASTM C 1048. Measure the lites on a vertical plane with an aluminum straight edge or fishing line.
      - 1) Measure the mockup glass lites for compliance with the bow and warp tolerances under Article "Heat-Treated Float Glass," Paragraph "Flatness Tolerances."
    - b. Document and record results for each glass lite. Tag each glass lite that falls outside of the maximum bow and warp limits and certify that these non-conforming glass lites will not be incorporated into the Work.
      - 1) Provide written documentation of the bow and warp readings in fractions of an inch or millimeters for each mockup glass lite to the Owner and Architect at the preconstruction glass mockup meeting. Provide additional written documentation as requested by the Owner and Architect.
  2. Roll Ripple Distortion (Flatness) Tolerance Testing:

- a. Prior to the visual observation by the Architect and Owner of the preconstruction glass mockups, measure each monolithic lite in the mockup containing low emissivity coated, unfritted, heat-treated glass having a 1/4-inch- thickness or greater using a LiteSentry or Osprey Series type optical scanning measurement device complying with ASTM C 1652 for digital grid scanning glass devices.
    - 1) Measure the monolithic mockup glass lites for compliance with the flatness tolerances under Article "Heat-Treated Float Glass," Paragraph "Flatness Tolerances."
  - b. Document and record results for each glass lite. Tag each glass lite that falls outside of the maximum flatness limits and certify that these non-conforming glass lites will not be incorporated into the Work.
    - 1) Provide written documentation of the flatness readings in fractions of an inch, in millimeters, and in millidiopters, for each mockup glass lite to the Owner and Architect at the preconstruction glass mockup meeting. Provide additional written documentation as requested by the Owner and Architect.
3. Color Tolerance Testing:
- a. Prior to the visual observation by the Architect and Owner of the preconstruction glass mockups, measure each monolithic mockup glass unit using either an off-line, or on-line, spectrophotometer. Color measurement shall be taken from the uncoated side.
    - 1) Tolerance limits for the color variation shall be as accepted on the visual mockup.
  - b. Document and record results for each glass unit. Tag each unit of glass that falls outside of the color variation limits and certify that these non-conforming glass units will not be incorporated into the Work.
- I. Quality Control (Production) Testing: As a minimum, provide the following quality control (production) testing for the exterior glass units:
1. Bow and Warp Distortion (Flatness) Tolerance Testing:
    - a. During the production of the heat-treated glass lites, measure for bow and warp in accordance with ASTM C 1048. Measure the lites on a vertical plane with an aluminum straight edge or fishing line.
      - 1) Measure the monolithic glass lites for compliance with the bow and warp tolerances under Article "Heat-Treated Float Glass," Paragraph "Flatness Tolerances," unless otherwise accepted by the Owner and Architect at the preconstruction glass mockup.

- b. During glass production, and once an hour, randomly select a single heat-treated glass lite and measure it. Document and record results. Tag each glass lite that falls outside of the maximum bow and warp limits and certify that these non-conforming glass lites were not incorporated into the Work.
  - c. Provide written documentation of the bow and warp readings in fractions of an inch or millimeters for each tested glass lite to the Owner and Architect, if requested. Provide additional written documentation as requested by the Owner and Architect.
2. Roll Ripple Distortion (Flatness) Tolerance Testing:
- a. During the production of the heat-treated glass lites, measure each low emissivity coated, unfritted, monolithic glass lite having a 1/4-inch- thickness or greater using a LiteSentry or Osprey Series type optical scanning measurement device complying with ASTM C 1652 for digital grid scanning glass devices.
    - 1) Measure the monolithic glass lites for compliance with the flatness tolerances under Article "Heat-Treated Float Glass," Paragraph "Flatness Tolerances," unless otherwise accepted by the Owner and Architect at the preconstruction glass mockup.
  - b. Document and record results for each glass lite. Tag each glass lite that falls outside of the maximum flatness limits and certify that these non-conforming glass lites were not incorporated into the Work.
    - 1) Provide written documentation of the flatness readings in fractions of an inch, in millimeters, and in millidiopters, for each glass lite to the Owner and Architect, if requested. Provide additional written documentation as requested by the Owner and Architect.
3. Color Tolerance Testing: During production, test monolithic coated and coated insulating glass units for color compliance as follows:
- a. Establish a color target selected from the accepted pre-construction glass mockup unit(s) and perform quality control color control checks using either an off-line, or on-line, spectrophotometer. Examples of acceptable off-line devices include Minolta 2500d/2600d; examples of acceptable on-line devices include Benchmodel Spectrophotometers. Color measurement shall be taken from the uncoated side.
  - b. Frequency: Test a minimum of one unit every hour.
  - c. Document and record results for each glass unit. Tag each unit of glass that falls outside of the color variation limits and certify that these non-conforming glass units will not be incorporated into the Work.
4. Insulating Glass Unit Testing Requirements: During production, test insulating glass units as follows:
- a. Butterfly Unit Adhesion Pull Testing:

- 1) Adhesion Criteria: Comply with the pass/fail requirements of the sealant manufacturer's published guidelines and/or sealant manufacturer's certification audit requirements/recommendations. Minimum pull back to 30 degrees from horizontal with no adhesive failure.
  - 2) Frequency: Test one minimum 4-by-6-inch- size unit each eight-hour shift and after each sealant drum change.
  - 3) Test units shall be fabricated on the same production line and processing equipment and with the same spacers and sealant used in the production of the insulating glass units fabricated for the Project.
- b. Desiccant Temperature Rise Testing:
- 1) Test Criteria: Comply with the desiccant manufacturer's written recommendations.
  - 2) Frequency: Test a minimum of once every eight-hour shift and after each drum change.
- c. Bow/Warp and Air Space Measurement Concave/Convex Testing:
- 1) Measure and record bow and warp once every hour on a vertical plane with an aluminum straight edge or with a laser.
  - 2) Measure and record unit center air space a minimum of once an hour with a checking gage (FDR Designs, or equal) and visually inspect all units.
- d. Skips and voids in the primary or secondary seals are prohibited and maximum gap at primary/secondary seal interface shall be 1 inch in length and 3/32 inch in width.
- e. Document and record results. Provide additional documentation upon request by the Owner or Architect.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Protect glazing materials according to 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. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting (using either breather or capillary tubes) and sealing.

## **1.6 FIELD CONDITIONS**

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.



## 1.7 WARRANTY

- A. Manufacturer's Special Warranty on Laminated Glass: Written warranty, made out to Owner and signed by laminated-glass manufacturer agreeing to furnish replacements for laminated-glass units that develop edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those specified within the warranty period indicated below. Upon notification of such deterioration within the warranty period, furnish replacement glass units for those glass units having edge separation, delamination, and blemishes at the convenience of the Owner.
1. Warranty Period: Five years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Insulating Glass: Written warranty, made out to Owner and signed by insulating-glass manufacturer agreeing to furnish replacements for insulating-glass units whose hermetic seal has failed within specified warranty period indicated below. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass. Upon notification of such deterioration within the warranty period, furnish replacement glass units for failed glass units at the convenience of the Owner.
1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PRODUCTS AND MANUFACTURERS

- A. Refer to Finish Schedule on the Drawings for the extent of glass types and locations. Glass types indicated on the Drawings are keyed to the Part 3 Glass Schedule Articles at the end of this Section. The Contractor shall confirm the levels of heat-treatment required for each glass type scheduled as contained in "Performance Requirements" and "Quality Assurance" Articles.

### 2.2 PERFORMANCE REQUIREMENTS

- A. General: Provide and install watertight and airtight glazing systems capable of withstanding thermal movement and wind and impact loads without failure of any kind, including loss or breakage of glass, failure of seal or gaskets, exudation of glazing sealants, and excessive deterioration of glazing materials.
- B. Glass Design: Glass thicknesses and heat treatments indicated are minimum requirements. Glazing details shown are for convenience of detailing only and are to be confirmed by the Contractor relative to cited standards and final framing details. Confirm glass thicknesses and heat treatments, verified by analysis, as required to meet the performance and testing requirements specified in Section 08 44 13.13 "Glazed Aluminum Window Walls,"

C. Thermal and Optical Performance Properties: Provide insulating glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For insulating-glass units, properties are based on units with lites 6 mm thick and a nominal 1/2 inch wide interspace.
2. Center-of-Glass U-Values: NFRC 100 methodology using LBL WINDOW 6.3 computer program, expressed as Btu/ sq. ft. x h x deg F.
3. Solar Heat Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL WINDOW 6.3 computer program.
4. Visible Reflectance (Solar Optical) Properties: Center-of-glazing values, according to NFRC 300.

### 2.3 PRIMARY FLOAT GLASS

A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Quality q3 (glazing select); Class 1, clear, or Class 1, ultra clear low iron with visible light transmission of not less than 91 percent, Class 2, tinted as indicated in schedules.

1. Ultra Clear, Low Iron Glass: Where indicated in the schedules clear, low iron glass shall mean low iron products as follows:
  - a. AGC Asahi Glass Co. Ltd.; Krystal Klear.
  - b. Guardian Industries Corp.; UltraWhite.
  - c. Pilkington North America; Optiwhite.
  - d. Vitro S.A.B. de C.V. "Acuity."
2. In order to reduce the possibility of glass color range rejection, the supplier of float (primary) glass products shall provide glass for the entire Project from a single facility using stockpiled batch run materials from a single source for the entire Project.
3. Float Glass Quality Imperfection Limitations: In addition to the limitations included under ASTM C 1036, all glass shall be supplied meeting the following quality standards:
  - a. Point blemishes - seeds/stones with distortion, stain spots, dirt, surface damage - shall be limited to 0.060 inch maximum separated by 12 inches minimum.
  - b. Glass scratch/rubs shall be rejected if detectable at 10 feet.
  - c. Water blow-off stains, tag residue, and handprints will not be permitted.

### 2.4 HEAT-TREATED FLOAT GLASS

A. General: Heat-treat glass where the need is determined by thermal stress analyses, by wind load analyses, and where required to meet safety glazing requirements.

B. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of installed glass unit.

- C. Fabrication Process: By vertical (tong-held) or horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of installed glass unit if roller hearth process selected, except provide horizontal process where indicated as tongless or free of tong marks.
- D. Sizes and Cutting: Prior to heat treatment, cut glass to required sizes as determined by accurate measurement of openings to be glazed, making allowance for required edge clearances. Cut and process edges in accordance with glass manufacturer's recommendations. Do not cut or treat edges in the field. Make all cuts for hardware, access, or glass-mounted trim or accessories before heat treating.
- E. Heat-Strengthened Glass: Provide glass complying with ASTM C 1048 Kind HS. Surface compression range shall be between 4,000 psi and 7,000 psi for 1/4 inch thick glass. Surface compression range shall be between 5,000 psi (34.5 MPa) and 8,000 psi (55.2 MPa) with an allowable surface compression tolerance of +/- 1,000 psi for 3/8 inch (10 mm) thick glass.
1. Heat-Strengthened Glass Quality Imperfection Limitations: In addition to the limitations included under ASTM C 1048, all glass shall be supplied meeting the following quality standards:
    - a. Chill cracks, roller marks, and picture framing shall not be permitted.
    - b. Tracking/cloud and heat dimples shall be rejected if detectable at 10 feet.
- F. Fully Tempered Glass: Provide glass complying with ASTM C 1048 Kind FT and meeting the requirements of ANSI Z97.1 for Category A performance and 16 CFR 1201 for Category II performance. Surface compression shall be equal to or greater than 10,000 psi. After tempering, heat-soak 100 percent of all fabricated glass units to European Union Standard EN14179 to reduce the potential for inclusion related glass breakage. Statistical heat soaking shall not be permitted.
1. The appearance of anisotropy, also known as 'leopard spots' • and 'quench patterns', is known to be associated with toughened (tempered) glass under certain polarized lighting conditions. This will not be considered a fault unless it is visible in a range of reasonably typical naturally occurring conditions. The Architect will determine the acceptable range(s) of anisotropy from glass sample submittals. Coatings applied to tempered glass products shall not exacerbate anisotropy to an unacceptable range(s).
  2. Tempered Glass Quality Imperfection Limitations: In addition to the limitations included under ASTM C 1048, all glass shall be supplied meeting the following quality standards:
    - a. Chill cracks, roller marks, and picture framing shall not be permitted.
    - b. Tracking/cloud and heat dimples shall be rejected if detectable at 10 feet.
- G. Flatness Tolerances: All heat-treated glass shall be fabricated to the following flatness tolerances. Verification of compliance for overall bow and warp shall be in accordance with ASTM C 1048. Verification of compliance for flatness shall be via an optical scanning device such as LiteSentry or Osprey Series.

1. Overall Bow and Warp: Not greater than the maximum bow and warp tolerances in any direction as listed in ASTM C 1048 Table 2. Localized warp limited to 1/32 inch in 12 inches.
  2. Roll Ripple: The deviation from flatness at any peak (peak to valley deviation) shall not exceed 0.003 inches for 6 mmthick glass in the glass center, with leading and trailing edge deviation not to exceed 0.008 inches for 6 mmthick glass.
- H. Millidiopter Criteria: Maximum +/- 120 millidiopters overall or the highest overall measurement from the approved visual mockup that is less than +/- 120 millidiopter overall whichever is less when viewed outdoors.

## 2.5 COATED FLOAT GLASS

- A. General: Provide coated glass complying with requirements indicated in this Article, under Paragraph "Insulating Glass," and in schedules.
1. Sputter-Coated Float Glass: Float glass with the coating(s) specified in schedules, deposited by magnetron sputtered vacuum deposition process after manufacture and heat treatment. Post-temperable glass coatings will not be permitted on glass thicknesses of greater than 1/4 inch Pyrolytic, and wet chemical deposition glass coatings will not be permitted.
  2. Coating Quality: The allowable range of defects in coatings applied to glass shall be as accepted through glass sample submissions. Installed coated glass products which are outside of the accepted sample range shall be subject to rejection by the Architect. All coated glass shall be provided from a single coating facility. The allowable range of defects are defined as follows:
    - a. The vision glass area is defined as the field of glass which is greater than 1 inch from the glass unit edge.
      - 1) Pinholes: At an indoor viewing distance of 10 feet for non-reflective and reflective low emissivity coatings:
        - a) Pinholes greater than 1/16 inch in diameter shall not be permitted in 80 percent of the central portion of the vision glass area and separated by greater than or equal to 12 inches. Pinholes larger than 3/32 inch are not allowed in the outer 20 percent of the perimeter vision glass area and separated by greater than or equal to 12 inches.
        - b) No more than two readily apparent blemishes are allowed in a 3 inch diameter circle and no more than five readily apparent blemishes are allowed in a 12 inch diameter circle.
      - 2) Scratches: At an indoor viewing distance of 10 feet for non-reflective and reflective low emissivity coatings, and 15 feet for reflective coatings:

- a) Scratches are allowed in 80 percent of the central glass area if not detectable at the viewing distance, and scratches less than or equal to 1 inch are allowed in the outer 20 percent area if not detectable at the viewing distance. Concentrated scratches or abraded areas are not allowed.
  - b) Scuffs, rub marks, cup marks, or abraded areas shall not be permitted in any glass area.
- 3) Reflectance and Transmission Inspection: When viewed outdoors against a bright uniform opaque background at a distance of 10 feet for low emissivity coatings, color, reflectance and transmission will be permitted to have a slight variance subject to Architect's acceptance.
- a) Mottling and streaking of the coating shall not be permitted.
  - b) Coating arcing will not be permitted.
  - c) Water blow-off stains will not be permitted.
  - d) Handprints will not be permitted.
  - e) Roller marks shall not be permitted.
  - f) Positive and negative air distortion shall not be permitted.
  - g) Tag residue shall not be permitted.
3. Edge Deletion Quality Criteria for Coated Glass Layers Used in Insulating Glass Assemblies:
- a. Edge deletion of coating to be uniform in appearance (no skips or streaks) and visually straight around the entire perimeter of the glass unit.
  - b. Edge deletion shall remove a minimum of 95% of the coating.
  - c. Edge deletion shall be 1/8 inch less than calculated sightline with a tolerance of +/-1/8 inch.
  - d. Perform sealant adhesion testing to ensure that the secondary and primary sealants yield acceptable adhesion to edge deleted areas of coated glass products.
  - e. Adhesion testing at the edge deleted area of the coated glass products shall be performed intermittently throughout the days production.
  - f. Comply with pass/fail requirements of the insulating glass unit manufacturers published guidelines and/or the manufacturers certification audit requirements/recommendations.

## 2.6 LAMINATED GLASS

- A. Laminated Glass: Comply with ASTM C 1172 for kinds of laminated glass indicated and other requirements specified, including those in the Glass Schedule.
- B. Interlayer: Unless indicated otherwise, provide 0.060 inch thick polyvinyl butyral (PVB) sheet or ionoplast sheet interlayer material with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.
  1. All interlayer furnished for the Project shall have been manufactured by one of the following:

- a. Eastman Chemical Company.
  - b. Kuraray.
- C. Laminating Process: Prior to laminating, cut glass to required sizes and profiles as determined by accurate measurement of openings to be glazed, making allowance for required edge clearances. Cut and process edges in accordance with glass manufacturer's recommendations. Do not cut or treat edges in the field. Fabricate laminated glass to produce glass free of scuff vinyl markings, handprints, tag residue, and foreign substances such as lint, hair, vinyl shavings in the central glass area and the outer 20 percent area when viewed from a distance of 39 inches and 10 feet, respectively. Handprints, tag residue, scuff vinyl markings, and foreign substances must be separated by more than 12 inches if not detectable at less than the viewing distances. Delaminations, blow-ins, short interlayers, and air or gas pockets shall not be permitted in the central glass area. In the outer 20 percent area, delamination will not be permitted; blow-ins, air or gas pockets, and short interlayers shall be limited to a maximum dimension of 3/32 inch in diameter, 3/32 inch in diameter, and 1/16 inch long, respectively. Laminate units as follows:
1. Laminate lites with interlayer in autoclave with heat plus pressure.

## 2.7 INSULATING GLASS

- A. Insulating-Glass Units: Preassembled units, with dehydrated entrapped air, consisting of sheets of glass hermetically sealed at all edges with a black polyisobutylene primary and a black silicone secondary elastomeric sealant. The black silicone secondary elastomeric sealant sightlines (width) shall be uniform for each insulating glass unit and, where exposed in 2, 3, and 4 sided wet glazing assemblies, sized for the highest wind pressure in the facade. The lites of glass shall be separated by desiccant containing black colored aluminum spacers. All insulating glass units shall be IGCC certified to comply with ASTM E 2190 and with requirements specified in this Article and in the Glass Schedule.
1. Provide Kind HS (heat-strengthened) float glass where needed to comply with "Performance Requirements" Article. Provide Kind FT (fully tempered) where safety glass is indicated.
- B. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated in the Glass Schedule are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.

## 2.8 FIRE-RATED GLAZING PRODUCTS

- A. Laminated Ceramic Glazing Material: Two lites of clear ceramic glazing material laminated together to produce a laminated lite of minimum 5/16 inch nominal thickness; polished on both surfaces; weighing 4 lb/sq. ft.; and as follows:
1. Fire-Protection Rating: As indicated for the assembly in which the glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.

2. Polished on both surfaces, transparent.
3. Product: Provide one of the following:
  - a. "FireLite Plus"; Nippon Electric Glass Co., Ltd. and distributed by Technical Glass Products.
  - b. Schott Pyran Platinum L; McGrory Glass.
  - c. Keralite FR-L; Vetrotech.

## 2.9 GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
  1. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Gasket, Blocking, and Spacer Wet Glazing Materials: Silicone, compatible with and adherent to each material it will be in contact with, as recommended by the manufacturer to fulfill performance requirements.
- C. Structural and Butt Glazing Sealants: Refer to Section 07 92 00 "Joint Sealants," Article "Elastomeric Joint Sealants," subparagraph "Structural Glazing."
- D. Glazing Sealant for Fire-Resistive Glazing Products: Identical to product used in test assembly to obtain fire-protection rating.
  1. VOC Content: Provide architectural glazing sealants and sealant primers having not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.10 GLAZING GASKETS

- A. Dense Compression Gaskets:
  1. Neoprene: Continuous extruded neoprene with, cross sectional profile, physical properties, and tolerances as recommended by the window and window wall manufacturer, and as required, to comply with the performance requirements specified and shown all in compliance with the applicable provisions of ASTM C 864, Option II. Provide injection molded corners.
  2. EPDM: Continuous extruded EPDM with cross sectional profile, physical properties, and tolerances as recommended by the window and window wall manufacturer, and as required, to comply with the performance requirements specified and shown all in compliance with the applicable provisions of ASTM C 864, Option II. Provide injection molded corners.

3. Silicone: Continuous extruded silicone with cross sectional profile, physical properties, and tolerances as recommended by the window and window wall manufacturer, and as required, to comply with the performance requirements specified and shown all in compliance with the applicable provisions of ASTM C 1115, Type C. Provide injection molded corners.
  4. Thermoplastic Polyolefin Rubber: Continuous extruded thermoplastic polyolefin rubber with cross sectional profile, physical properties, and tolerances as recommended by the window and window wall manufacturer, and as required, to comply with the performance requirements specified and shown all in compliance with the applicable provisions of ASTM C 1115. Provide injection molded corners.
  5. Any material indicated above.
- B. Soft Compression Gaskets: Continuous extruded expanded foam with, cross sectional profile, physical properties, and tolerances as recommended by the window and window wall manufacturer, and as required, to comply with the performance requirements specified and shown all in compliance with the applicable provisions of ASTM C 509, Option II, Type II; provide the following:
1. EPDM.
  2. Silicone.
  3. Thermoplastic polyolefin rubber.
  4. Any material indicated above.
- C. Continuous Structural Gaskets/Spacers: Continuous extruded silicone or silicone compatible rubber, with cross sectional profile, physical properties, and tolerances as recommended by the window and window wall manufacturer, and as required, to comply with the performance requirements specified and shown. Gaskets/spacers shall be tested for compatibility with silicone sealants and shall be subject to the acceptance of the sealant manufacturer.

## 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, and wet glazing materials, contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: EPDM complying with ASTM C 864 (Option II), blocks, 85 +/- 5 Shore A durometer hardness, 1/16 inch less than the channel width, and length based on the face area of the glass unit to be supported in accordance with GANA standards and glass manufacturer recommendations, but not less than 4 inches.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness of 40 to 60.
- E. Edge Blocks: EPDM complying with ASTM C 864 (Option II), blocks, 65 +/- 5 Shore A durometer hardness, minimum 4 inches long and sized to allow 1/8 inch clearance between edge of glass and block.



- F. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

## 2.12 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

- A. Fabricate glass and other glazing products in sizes required to glaze 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 standard, to comply with system performance requirements.
1. Edge and Surface Conditions: Comply with the recommendations of AAMA "Structural Properties of Glass" for "clean-cut" edges, except comply with manufacturer's recommendations when they are at variance therewith.
  2. Exposed Glass Edges and Surface Condition: All edges shall be flat with an arrissed edge profile (small bevel of uniform width not exceeding 1/16 inch at an angle of approximately 45 degrees to the surface of the glass) with a polished (surface is reflective in appearance similar to the major surface of the glass) surface.
- B. Cutting: Do not nip glass edges. Edges may be wheel cut or sawed and seamed at manufacturer's option. For glass to be cut at site, provide glass 2 inches larger than required in both dimensions, so as to facilitate cutting of clean cut edges without the necessity of seaming or nipping. Do not cut, seam, nip or abrade heat-treated glass.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine glass framing, with glazier and glass framing erector present, for compliance with the following:
1. Compliance with the specified manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  2. Presence and functioning of weep system.
  3. Minimum required face or edge clearances.
  4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean glazing stops, glazing channels, and rabbets which will be in contact with the glazing materials immediately before glazing. Loose particles present or resulting from fabrication and cleaning shall be removed by blowing out joints with oil-free compressed air, or by vacuuming joints. Remove protective coatings, oils from cutting and drilling operations, and residue on metallic surfaces with solvents that leave no residue. Do not allow solvent to air dry without wiping. Use only lint-free towels for wiping of surfaces. Wipe metal surfaces with IPA (isopropyl alcohol) unless otherwise required by compatibility and adhesion testing results.
  - 1. Prime surfaces to receive glazing compounds. When priming, comply with wet glazing manufacturer's recommendations.
- B. Inspect each glass unit immediately before installation. Do not install any units which are improperly sized or have damaged edges, scratches or abrasion or other evidence of damage. Remove labels from glass immediately after installation.

### 3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
  - 1. All glass units shall be installed in accordance with the glass manufacturer's recommendations.
    - a. Field Glazed Structural Silicone Window and Curtain Wall Units: Set full height continuous structural gaskets/spacers to vertical mullions. Set glass units with void between edge of units and head/sill channel, but with units fully within head/sill rebate so as to provide a proper bite. Align glass unit edges over vertical mullion continuous structural gasket/spacers and secure with manufacturer's recommended temporary cleats. Structurally seal glass unit to vertical mullions with specified one-part structural silicone sealant. Tool structural silicone flush in alignment to mullion face and perpendicular to face of interior glass lite; remove excess structural silicone from glass and metal substrates. After full cure of structural silicone sealant, remove temporary cleats. Any holes left in the vertical mullions which were caused by the temporary cleats shall be sealed immediately. Insert and shape weatherseal joint backer rods, or gaskets, into vertical void between glass units and at a proper depth to receive silicone weatherseal sealant. Place silicone weatherseal sealant into void and tool flush with adjacent exterior glass lite faces; remove excess sealant from glass and metal substrates.
- B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, with reasonable tolerances. Adjust as required by Project conditions during installation.

- 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 surfaces indicated to receive glazing materials. Use primers as determined by preconstruction compatibility and adhesion testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless more stringent requirements are recommended by glass manufacturer. Place blocks to allow water passage to weep holes. Set blocks in thin course of silicone sealant.
  - 1. For Glass Units Less Than 72 inches: Locate setting blocks at sill one-quarter of the width in from each end of the glass, unless otherwise recommended by the glass manufacturer.
  - 2. For Glass Units 72 inches or Greater: Locate setting blocks at sill one-eighth of the width in from each end of the glass, but not less than 6 inches, unless otherwise recommended by the glass manufacturer.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where the length plus width is larger than 50 inches as follows:
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8 inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking to prevent glass lites from moving sideways in glazing channel, sized and located to comply with the glass manufacturer's recommendations and the requirements in referenced glazing publications.
  - 1. Edge blocking will not be required at structural glazed window and window walls unless specifically required by the glass manufacturer for the conditions shown.
- I. Set glass lites with uniform pattern, draw, bow, and similar characteristics, producing the greatest possible degree of uniformity in appearance on the entire exterior wall elevation.
  - 1. Set glass units with void between edge of units and glazing channel.
  - 2. Shadow Box Enclosure Glazing: Remove any dirt, window and window wall debris, and construction debris, from interior portion of shadowbox enclosures. Where lubricants are recommended for the installation of glazing gaskets, use types which will not release volatiles, or leave visible deposits or residues, on inside of spandrel glass units or metal back panels.

3. Orient and install insulating glass units made up with one lite of low emissivity coated glass with the uncoated glass lite on the inboard (building) side.
  4. Orient and install insulating glass units made up with one lite of tinted glass with the untinted glass lite on the inboard (building) side.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

### **3.4 LOCK-STRIP GASKET GLAZING**

- A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Use special tool to install and remove filler strips; lubricate in accordance with manufacturer's instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.

### **3.5 PROTECTION AND CLEANING**

- 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 them immediately as recommended 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 build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way and from any source, including natural causes, accidents, and vandalism.
- 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 by glass manufacturer.

### **3.6 GLASS TYPE SCHEDULE**

- A. GL-01: Laminated unit, made up of clear tempered glass inner and outer layers with 0.060-inch clear interlayer, glass thickness as required by structural performance criteria.
- B. GL-02: Monolithic clear tempered glass, thickness as required by structural performance criteria.
- C. GL-10: Insulating Glass Unit, composed of the following:

1. Tinted outboard light (Vitro Atlantica), Kind HS or FT as required by Code, thickness as required by structural performance requirements, with Solarban 60 low-E coating on #2 surface.
2. 1/2 inch air space.
3. Clear inboard light, Kind HS or FT as required by Code, 1/4 inch thick.
  - a. Confirm glass thicknesses based on structural performance requirements, as indicated in "Performance Requirements" Article.

D. GL-11: Insulating Glass Unit, composed of the following:

1. Ultraclear low iron outboard light, Kind HS or FT as required by Code, thickness as required by structural performance requirements, with Solarban 90 low-E coating on #2 surface.
2. 1/2 inch air space.
3. Ultraclear low iron inboard light, Kind HS or FT as required by Code, 1/4 inch thick.
  - a. Confirm glass thicknesses based on structural performance requirements, as indicated in "Performance Requirements" Article.

**END OF SECTION**

## **SECTION 09 21 16.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
1. Chase enclosures.
  2. Horizontal enclosures.

#### **1.2 QUALITY ASSURANCE**

- A. Single Source Responsibility: Obtain products for gypsum board shaft-wall assembly from a single manufacturer.

#### **1.3 FIELD CONDITIONS**

- A. Comply with requirements for environmental conditions, room temperatures, and ventilation specified in Section 09 29 00 "Gypsum Board."

### **PART 2 - PRODUCTS**

#### **2.1 PERFORMANCE REQUIREMENTS**

- A. Structural Performance:
1. Walls: Provide gypsum board shaft-wall assemblies engineered to withstand the following lateral design load (air pressure) and deflection limit for maximum heights of partitions required, without failing and while maintaining an airtight and smoke-tight seal.
    - a. Lateral Loading: 5 psf.
    - b. Deflection Limit: L/240.
  2. Horizontal Duct Enclosures: Provide gypsum board shaft-wall assemblies for horizontal duct enclosures capable of spanning distances indicated within deflection limit of L/360. Design clips and runners to allow unimpeded and recurring vertical movement, as determined by structural analysis, of not less than 1/2 inch and to provide positive attachment to structure.

- B. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory."

## 2.2 MANUFACTURERS

- A. Basis-of-Design Product: The design for gypsum board shaft-wall assemblies is based on products named on Drawings by design designation of a qualified testing and inspecting agency. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
1. American Gypsum Co.
  2. CertainTeed Corporation. [www.americangypsum.com](http://www.americangypsum.com)
  3. Georgia-Pacific Building Products. [www.gp.com/gypsum](http://www.gp.com/gypsum)
  4. National Gypsum Company. [www.national-gypsum.com](http://www.national-gypsum.com)
  5. United States Gypsum Company. [www.usg.com](http://www.usg.com)

## 2.3 MATERIALS AND COMPONENTS

- A. General: Comply with requirements of fire-resistance-rated assemblies indicated.
1. Provide panels in maximum lengths available to eliminate or minimize end-to-end butt joints.
  2. Provide auxiliary materials complying with gypsum board shaft-wall assembly manufacturer's written recommendations.
- B. Steel Sheet Components: Metal complying with ASTM C 645 requirements.
1. Protective Coating: Manufacturer's standard corrosion-resistant zinc coating.
- C. Studs: Manufacturer's standard profile for repetitive members and corner and end members and for fire-resistance-rated assembly indicated.
- D. Track (Runner): Manufacturer's standard J-profile track with long-leg length as standard with manufacturer, but at least 2 inches, in depth matching studs.
1. Minimum Base Metal Thickness: 0.0312 inch.
- E. Jamb Struts: Manufacturer's standard J-profile strut with long-leg length of 3 inches, in depth matching studs, and not less than 0.0341 inch thick.
- F. Gypsum Liner Panels: Manufacturer's proprietary liner panels in 1 inch thickness and with moisture-resistant paper faces.

- G. Gypsum Board: ASTM C 1396/C 1396M, core type as required by fire-resistance-rated assembly indicated.
  - 1. Edges: Tapered.
- H. Water-Resistant, Gypsum Backing Board: ASTM C 630/C 630M, core type as required by fire-resistance-rated assembly indicated.
- I. Accessories: Cornerbead, edge trim, and control joints of material and shapes specified in Section 09 29 00 "Gypsum Board" that comply with gypsum board shaft-wall assembly manufacturer's written recommendations for application indicated.
- J. Gypsum Board Joint-Treatment Materials: ASTM C 475 and as specified in Section 09 29 00 "Gypsum Board."
- K. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
  - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
  - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- L. Track (Runner) Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft-wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
  - 1. Powder-Actuated Fasteners: Provide powder-actuated fasteners with capability to sustain, without failure, a load equal to 10times that imposed by shaft-wall assemblies, as determined by testing conducted by a qualified independent testing agency according to ASTM E 1190.
- M. Acoustical Sealant: As specified in Section 09 29 00 "Gypsum Board."
- N. Sound Attenuation Blankets: ASTM C 665 for Type I, unfaced mineral-fiber-blanket insulation produced by combining thermosetting resins with mineral fibers manufactured from slag or rock wool.
  - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install gypsum board shaft-wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and the following:



1. ASTM C 754 for installing steel framing.
  2. Section 09 29 00 "Gypsum Board" for applying and finishing panels.
- B. Do not bridge building expansion joints with shaft-wall assemblies; frame both sides of joints with furring and other support.
- C. Install supplementary framing in gypsum board shaft-wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, and similar items that cannot be supported directly by shaft-wall assembly framing.
- D. At penetrations in shaft wall, maintain fire-resistance rating of shaft-wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.
- E. Isolate gypsum finish panels from building structure to prevent cracking of finish panels while maintaining continuity of fire-rated construction.
- F. Install control joints to maintain fire-resistance rating of assemblies.
- G. Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly. Install acoustical sealant to withstand dislocation by air-pressure differential between shaft and external spaces; maintain an airtight and smoke-tight seal; and comply with manufacturer's written instructions or ASTM C 919, whichever is more stringent.
- H. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

**END OF SECTION**

## **SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes non-structural metal framing assemblies.

#### **1.2 QUALITY ASSURANCE**

- A. Fire-Test-Response Characteristics: For non-structural metal framing assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory."
- B. Sound Transmission Characteristics: For non-structural metal framing faced with gypsum wallboard materials and having STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.
  - 1. STC-Rated Assemblies: Indicated by design designations from GA-600, "Fire Resistance Design Manual."

#### **1.3 FIELD CONDITIONS**

- A. Comply with ASTM C 754 requirements or wallboard material manufacturer's written recommendations, whichever are more stringent.

### **PART 2 - PRODUCTS**

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

- A. General: For fire rated assemblies, provide materials, including accessories and fasteners produced by one manufacturer, or, when products of more than one manufacturer are used in a rated system, they shall be acceptable to authorities having jurisdiction.

#### **2.2 PERFORMANCE REQUIREMENTS**

- A. Gypsum Board Assembly Deflections:

1. Typical Walls: Wall assemblies shall be constructed for deflection not to exceed 1/240 of the wall height when subjected to a positive and negative pressure of 5 psf.
2. Walls with Tile Finish: Wall assemblies to receive tile finishes shall be constructed for deflection not to exceed 1/360 of the wall height when subjected to a positive and negative pressure of 5 psf.
3. Ceilings, bulkheads, soffits, ceiling transitions, ledges, and coves shall be constructed for a deflection not to exceed 1/360 of the distance between supports.

### **2.3 STEEL SUSPENDED CEILING FRAMING**

- A. Components, General: Provide steel framing members sized and spaced as indicated but not less than that required to comply with ASTM C 754 under the maximum deflection conditions specified under Article 'Assembly Performance Requirements.'
- B. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625 inch diameter wire, or double strand of 0.0475 inch diameter wire.
- C. Hanger Attachments to Overhead Decks: Suitable for application indicated, fabricated from corrosion-resistant materials, with eyepins, clips or other devices for attaching hangers and capable of sustaining, without failure, a load equal to 10 times that imposed by the complete ceiling system.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch, a minimum 1/2 inch wide flange, with manufacturer's standard corrosion-resistant zinc coating.
- E. Furring Channels (Furring Members): Commercial-steel sheet with ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating. No equivalent coatings allowed.
  1. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
    - a. Minimum Base Metal Thickness: 0.0312 inch.

### **2.4 STEEL PARTITION AND SOFFIT FRAMING**

- A. General: Provide steel framing members sized and spaced as indicated but not less than that required to comply with ASTM C 754 under the maximum deflection conditions specified under Article 'Assembly Performance Requirements.'
  1. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating. No equivalent coatings (EQ) allowed.
- B. Steel Studs and Runners: ASTM C 645, in minimum depth indicated in partition type details; one of the following:
  1. Allsteel & Gypsum Products, Inc.

2. CEMCO.
  3. Clark Dietrich.
  4. Consolidated Fabricators, Corporation.
  5. Craco Manufacturing, Inc.
  6. Custom Stud, Inc.
  7. Marino\WARE.
  8. Phillips Manufacturing Company.
  9. Quail Run Building Materials, Inc.
  10. SCAFCO Corporation.
  11. Telling Industries.
  12. The Steel Network.
  13. United Metal Products.
  14. Minimum Base Metal Thickness:
    - a. Typical: As required to comply with deflection criteria but not less than 0.0312 inch.
    - b. Partitions Supporting Wall Mounted Casework: 0.033 inch minimum thickness.
  15. Depth: As indicated.
- C. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
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. CEMCO; CST and SLP-TRK brand Slotted Slip Tracks, City of Industry, CA.
    - b. ClarkDietrich Building Systems; Max Trak (SLT) Slotted Deflection Track, West Chester, OH.
    - c. Metal-Lite, Inc.; Slotted Track.
    - d. The Steel Network, Inc; VertiClip SLD Series or VertiTrack VTD Series.
- D. Firestop Track: ASTM C 645 top runner with custom fabricated flanges with depths sized to accommodate roof and floor deck live and dead load deflections but not less than 2 inch deep flanges. Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CEMCO; FAS Track 1000 Slotted Deflection Track, City of Industry, CA.
    - b. Metal-Lite, Inc.; The System.
    - c. The Steel Network, Inc.; VertiClip SLD Series or VertiTrack VTD Series.
- E. Flat Strap and Backing Plate: 36 inch wide by 6 inch high steel sheet for blocking and bracing required for the attachment of surface mounted items and accessories indicated. Locate to span a minimum of 2 studs.

1. Minimum Base Metal Thickness: 0.0312 inch.
- F. Cold-Rolled Channel Bridging: For channel bridging for fixture attachment or lateral bracing provide 0.0538 inch bare steel thickness, with minimum 1/2 inch wide flange:
  1. Depth: 1-1/2 inches.
  2. Clip Angle: 1-1/2 by 1-1/2 inch, 0.068 inch thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
  1. Minimum Base Metal Thickness: 0.0179 inch.
  2. Depth: 7/8 inch.
- H. Resilient Furring Channels: 1/2 inch deep, steel sheet members designed to reduce sound transmission.
- I. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members securely to substrates involved; complying with the recommendations of the gypsum board manufacturers for applications indicated.

## 2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90. One of the following:
  1. SHEETROCK Acoustical Sealant; U.S. Gypsum.
  2. AC-20 FTR; Pecora.
- C. Isolation Strip at Exterior Walls: Adhesive-backed, closed-cell, compressible, non-extruding, sound transmission reducing, vinyl foam tape strips with approximately 13 Shore 00 hardness that allow fastener penetration without foam displacement, 0.75 inch thick, in width 1/2 inch less than window mullion width.
  1. V7324 Norton Sealant Tape; gray color.
- D. Metal Post for Tube Framing at Partial Height Walls: Refer to Section 05 50 00 "Metal Fabrications."

## **PART 3 - EXECUTION**

### **3.1 INSTALLING STEEL SUSPENDED CEILING FRAMING**

- A. Suspended Ceiling Framing:
1. Suspend ceiling hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. 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 the location of hangers 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 referenced standards.
  3. Attach hangers to structural members. Do not support ceilings from or attach hangers to permanent metal forms, steel deck tabs, steel roof decks, ducts, pipes, or conduit.
  4. Secure wire hangers by looping and wire-tying, to 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.
  5. Secure rod and flat hangers to structure, including intermediate framing members, by attaching to 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.
- B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet measured lengthwise on each member and transversely between parallel members.
- C. Wire-tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.
- D. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards unless more stringent spacings are recommended by the gypsum board manufacturer.

### **3.2 INSTALLING STEEL PARTITION AND SOFFIT FRAMING**

- A. Install continuous runners (tracks) sized to match studs at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction. Secure runners to substrates with fasteners spaced a maximum of 24 inches on center unless closer spacing is recommended by the framing manufacturer for the floor and ceiling construction involved. Provide fasteners at all corners and ends of runner tracks.
1. Where studs are installed directly against exterior walls, install foam gasket isolation strip between studs and wall.

2. Install two beads of sealant below floor tracks for acoustical and dust control.
- B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch from the plane formed by the faces of adjacent framing.
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings and at partial height partitions. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
1. Cut studs 1/2 inch short of full height to provide perimeter relief.
  2. For fire-resistance-rated and STC-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.
  3. Terminate partial height partition framing as indicated.
- D. Install steel studs and furring in sizes and at spacing indicated but not less than that required by the referenced steel framing installation standard to comply with maximum deflection and minimum loading requirements specified, unless more stringent requirements are recommended by the gypsum board manufacturer:
1. Space studs 16 inches on center, unless otherwise indicated.
- E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.
- F. Install backerplates for support of wall mounted items.
- G. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
1. Install two studs at each jamb, unless otherwise indicated. Install one additional stud no more than 6 inches from jamb studs at single doors greater than 48 inches and at all pairs of doors.
  2. Install cripple studs at head adjacent to each jamb stud. Provide runner track and typical studs above door openings with studs spaced not more than 24 inches on center.
  3. At all welded frames with fixed anchor clips secure stud reinforcing to jamb anchor clips with not less than two self tapping screws per clip.
  4. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
- H. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

- I. Isolation Strip Attachment: Where partitions abut exterior wall window mullions, and partition filler panels are not indicated, adhesively attach isolation strips to window mullions. Center isolation strips on mullion to form a continuous, sound resistant and lightproof, recessed joint seal for the entire length of the interface between the partition studs and trim members and the vertical window mullions.

**END OF SECTION**



## SECTION 09 24 00 - CEMENT PLASTERING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Exterior vertical plasterwork (stucco).
2. Exterior horizontal and nonvertical plasterwork (stucco).
3. Installation of building paper lath, and accessory flashings over weather barrier.

B. Related Requirements:

1. Section 05 40 00 "Cold-Formed Metal Framing" for structural, load-bearing (transverse and axial) steel studs and joists that support lath and Portland cement plaster.
2. Section 06 16 00 "Sheathing" for sheathing included in Portland cement plaster assemblies.
3. Section 07 21 65 "Wall Cladding Attachment System" for metal girts.
4. Section 07 25 00 "Weather Barriers"
5. Section 07 92 00 "Joint Sealants"
6. Section 09 29 00 "Gypsum Board" for sound attenuation batts.
7. Section 09 96 23 "Graffiti-Resistant Coatings" for protective coatings applied to cement plaster surfaces.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. CALgreen Submittals:

1. Product Data for Section 5.504.4.1.1: For sealants, adhesives and caulks, provide documentation including printed statement of VOC content showing compliance with SCAQMD Rule 1168 VOC limits and CCR (California Code of Regulations) Title 17 for aerosols.
2. Product Data for Section 5.504.4.1.2: Provide documentation for aerosol adhesives, and smaller unit sizes of adhesives, sealant, and caulking compounds (in units of product, less packaging, which do not weigh more than one (1) pound and do not consist of more than sixteen (16) fluid ounces) comply with statewide VOC standards and prohibitions on use of certain toxic compounds, of CCR Title 17, commencing with Section 94507.
3. Product Data for Section 5.504.4.3: For architectural paints and coatings, provide documentation including printed statement of VOC content showing compliance with Table 1 of the ARB, Architectural Coatings Suggested Control Measure, unless more stringent local limits apply.

4. Product Data for Section 5.504.4.3.1: Aerosol paints and coatings, provide documentation that products meet the PWMIR Limits for ROC in Section 94522 (a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Section 94522(c)(2 and (d)(2) of CCR Title 17.
- C. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.
- D. Calculations: Show calculations for metal framing demonstrating framing has achieved a minimum 1/600 at the time of plaster application.
  1. If stiffness cannot be achieved before glazing units have been installed into frames, provide additional temporary bracing for plastered surfaces. Remove temporary bracing after building has been fully enclosed.
- E. Samples: For each type of factory-prepared finish coat and for each color and texture specified.
- F. Samples for Initial Selection: For each type of factory-prepared finish coat and for each color and texture specified 12 by 12 inches and prepared on rigid backing.
- G. Samples for Verification: For each type of factory-prepared finish coat and for each color and texture specified, 12 by 12 inches, and prepared on rigid backing.

### **1.3 DELIVERY, STORAGE, AND HANDLING**

- A. Store materials inside under cover, and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

### **1.4 FIELD CONDITIONS**

- A. Comply with ASTM C 926 requirements.
- B. Exterior Plasterwork:
  1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
  2. Apply plaster when ambient temperature is greater than 40 deg F.
  3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.
  4. Protect contiguous work from damage by plastering operations. Do not allow runoff water from plaster to drain over glass or metal surfaces. Cover all window and door frames, sills, ledges, and pavement before starting plastering operations.
- C. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

## **PART 2 - PRODUCTS**

### **2.1 METAL LATH**

A. Welded Wire Lath: Wire Lath – ASTM C 933, Class 1 Galvanized Coating complying with ASTM A 641.

1. Structa Mega Lath by Structa Wire Corp.:
  - a. Self-Furring.
  - b. Weight 1.95 lb/yd<sup>2</sup> (1.1 kg/sq.m).
  - c. Finish – Class 1 Galvanized Coating complying with ASTM A641 .

B. Rib Lath at Soffit Conditions:

1. V Truss Wall & Ceiling by Structa Wire Corp:
  - a. Kraft paper backing.
  - b. Weight 2.2 lb/yd<sup>2</sup> (1.2 kg/sq.m)
  - c. Finish – Class 1 Galvanized Coating complying with ASTM A641.

### **2.2 ACCESSORIES**

A. General: Comply with ASTM C 1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:

1. General: Comply with ASTM C 1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Alabama Metal Industries Company; a Gibraltar Industries company.
  - b. CEMCO; California Expanded Metal Products Co.
  - c. ClarkDietrich Building Systems.
  - d. Stockton Products
  - e. Marino\WARE.
  - f. Phillips Manufacturing Co.
3. Cornerite: Fabricated from metal lath with ASTM A 653/A 653M, G60, hot-dip galvanized-zinc coating.
4. External- (Outside-) Corner Reinforcement: Fabricated from metal lath with ASTM A 653/A 653M, G60, hot-dip galvanized-zinc coating.
5. Cornerbeads: Fabricated from zinc.

- a. Smallnose cornerbead with solid flanges. Fabricated from zinc coated galvanized steel (minimum G90); square-edged style; with solid long leg flanges and no weep holes. Minimum 3-1/2 in. solid leg. J-B, J-Bead.
  - b. Smallnose cornerbead with expanded flanges; use at direct-applied stucco locations only.
6. Control Joints: Fabricated from zinc; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint. #XJ-15.
  7. Vertical Expansion Joints: Fabricated from zinc coated galvanized steel (minimum G90); two-piece slip type joints. No. 40 Two-Piece Expansion Joint.
  8. Horizontal Expansion Joints: Fabricated from zinc coated galvanized steel (minimum G90); two-piece slip type joint, allowing for up to 1 in. movement. M-Slide Expansion joint.
  9. Weep Screed: No. 7 foundation sill screed.
  10. Soffit Vent/Drip Screed: Fry DS-375-V-875 Soffit Vent/Drip Screed.
  11. Head Flashing: DHF, No. 6 Drip Head Flashing.
- C. Building Paper: Water-vapor-permeable, asphalt-saturated kraft building paper that complies with ICC-ES AC38, Grade D; except with water-resistance rating not less than 1 hour.
1. Two-Ply Super Jumbo Tex 60 min. by Fortifiber, or approved equal.

### 2.3 MISCELLANEOUS MATERIALS

- A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
- B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch long, free of contaminants, manufactured for use in cement plaster.
- C. Bonding Compound: ASTM C 932.
- D. Fasteners for Attaching Metal Lath to Substrates: Lath screws, per ASTM C 1063.
- E. Lath Screws by Teks.
- F. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch diameter unless otherwise indicated.
- G. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional regulations as shown in CALgreen Section 5.504.4.1.
- H. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds shall comply with regulations as shown in CALgreen Section 5.504.4.2.

## 2.4 PLASTER MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type II.
  - 1. Color for Finish Coats: Gray.
- B. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.
- C. Sand Aggregate: ASTM C 897.
- D. Adhesive Leveling Coat: Modified Portland cement adhesive and base coat, compatible with substrate, for embedment of reinforcing mesh.
  - 1. Basis of Design Product: La Habra Stucco Leveling Coat; Parex La Habra, or equal.
- E. Continuous Reinforcing Fabric: ASTM D578, balanced, open weave, alkali-resistant glass-fiber fabric, acceptable to plaster system manufacturer.
  - 1. Basis of Design Product: Standard reinforcing mesh, 4.5 oz./sq. yd.; Parex La Habra, or equal.
- F. Acrylic-Based Finish Coatings: Factory-mixed acrylic-emulsion coating systems formulated with colorfast mineral pigments and fine aggregates; for use over cement plaster base coats. Include manufacturer's recommended primers and sealing topcoats for acrylic-based finishes.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. California Stucco Products Corp.
    - b. Dryvit Systems, Inc.
    - c. El Rey Stucco Solutions; a Parex USA, Inc. brand.
    - d. Finestone, BASF Corp.
    - e. Master Wall Inc.
    - f. Omega Products International, Inc.
    - g. Senergy, BASF Corp.
    - h. Shamrock Stucco LLC.
    - i. SonoWall, BASF Corp.
    - j. Sto Corp.
    - k. Stuc-O-Flex International, Inc.
  - 2. Color: As selected by Architect from manufacturer's full range.
- G. Paints and coatings shall comply with VOC content as shown in CALgreen Section 5.504.4.3.

## 2.5 PLASTER MIXES

- A. General: Comply with ASTM C 926 for applications indicated.

1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. of cementitious materials.
- B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:
  1. Portland Cement Mixes:
    - a. Scratch Coat: For cementitious material, mix 1 part Portland cement and 0 to 3/4 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
    - b. Brown Coat: For cementitious material, mix 1 part Portland cement and 0 to 3/4 parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
- C. Base-Coat Mixes for Use over Concrete: Single base (scratch) coat for two-coat plasterwork on low-absorption plaster bases as follows:
  1. Portland Cement Mix: For cementitious material, mix 1 part Portland cement and 0 to 3/4 part lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
- D. Factory-Prepared Finish-Coat Mixes: For acrylic-based finish coatings, comply with manufacturer's written instructions.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify that surfaces are protected from direct sun, drying winds (real or artificial) and that substrates conform to ASTM C 926.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.
- B. Prepare smooth, solid substrates for plaster according to ASTM C 926.

### **3.3 INSTALLING FLASHINGS AND BUILDING PAPER**

- A. Install accessories to provide required depth of plaster and to bring plaster surface to required plane.
- B. Install sill and drip screed with air barrier, building paper and lath installed over attachment flange of screeds.
- C. Provide casing beads where plaster abuts dissimilar construction and at perimeter of openings where edges of plaster will not be concealed by other work.
- D. Building Paper: Apply two layers of building paper horizontally with a 2-inch overlap and a 6-inch end lap; fasten through sheathing into framing with lath fasteners. Seal all fastener heads.

### **3.4 INSTALLING METAL LATH**

- A. Metal Lath: Install according to ASTM C 1063.
  - 1. Partition Framing and Vertical Furring: Install self-furring, welded-wire lath.
  - 2. Flat-Ceiling and Horizontal Framing: Install rib lath.
  - 3. On Solid Surfaces, Not Otherwise Furred: Install direct-applied.

### **3.5 INSTALLING LATH ACCESSORIES**

- A. Install according to ASTM C 1063 and at locations indicated on Drawings.
- B. Reinforcement for External (Outside) Corners:
  - 1. Install cornerbead at exterior locations.
  - 2. Install cornerbead at interior locations.
- C. Control Joints and Expansion Joints: Locate as approved by Architect for visual effect and as follows:
  - 1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:
    - a. Vertical Surfaces: 144 sq. ft..
    - b. Horizontal and Other Nonvertical Surfaces: 100 sq. ft.
  - 2. At distances between control joints of not greater than 18 feet o.c.
  - 3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
  - 4. Where control joints occur in surface of construction directly behind plaster.

5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.
  6. Lath is discontinuous behind expansion and control joints per ASTM C1063. Coordinate with framing so there is continuous blocking for horizontal and vertical joints.
  7. Apply heavy sealant bead at joints and intersections of control joints and expansion joints.
  8. Provide continuous air barrier and fluid-applied flashing coverage behind control joints and expansion joints. Coordinate with Section 07 25 00 - "Weather Barriers".
- D. Fasten in place true to line and in correct relation to adjacent materials and as required to prevent dislodging and misalignment by subsequent operations.
- E. Install continuous corner reinforcement for full length of external corners.
- F. Seal lath and lath accessory fastener heads with sealant.

### 3.6 PLASTER APPLICATION

- A. General: Comply with ASTM C 926.
1. Typical Plaster Areas: Do not deviate more than plus or minus 1/4 inch in 10 feet from a true plane in finished plaster surfaces when measured by a 10-foot straightedge placed on surface.
    - a. Plaster Surfaces Indicated to Receive Painted Wall Graphics: Do not deviate more than plus or minus 1/8 inch in 10 feet from a true plane in finished plaster surfaces when measured by a 10-foot straightedge placed on surface.
  2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
  3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.
- B. Bonding Compound: Apply on unit masonry and concrete substrates for direct application of plaster.
- C. Walls; Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork with 7/8-inch total thickness, as follows:
1. Portland cement mixes.
- D. Ceilings; Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork and having 1/2-inch total thickness, as follows:
1. Portland cement mixes.



- E. Walls; Base-Coat Mix: For base (scratch) coat, for two-coat plasterwork and having 3/8-inch thickness on concrete, as follows:
  - 1. Portland cement mix.
- F. Ceilings; Base-Coat Mix: For base (scratch) coat, for two-coat plasterwork and having 1/4-inch thickness on concrete, as follows:
  - 1. Portland cement mix.
- G. Fully embed reinforcing mesh in lamina base coat in accordance with manufacturer's instructions, to provide substrate for finish coat.
- H. Plaster Finish Coats: Apply to provide smooth trowel finish at areas indicated to receive painted wall graphics; match Architect's sample for plaster finish in other areas..
- I. Acrylic-Based Finish Coatings: Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.
- J. Concealed Exterior Plasterwork: Where plaster application is used as a base for adhered finishes, omit finish coat.

### **3.7 PLASTER REPAIRS**

- A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

### **3.8 CLEANING AND PROTECTION**

- A. Remove temporary protection and enclosure of other work after plastering is complete. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

### **END OF SECTION**

## **SECTION 09 29 00 - GYPSUM BOARD**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
1. Interior gypsum board.
  2. Tile backing panels.

#### **1.2 QUALITY ASSURANCE**

- A. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.
- B. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.
- C. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Install mockups for the following:
    - a. Each level of gypsum board finish indicated for use in exposed locations.
  2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
  3. Simulate finished lighting conditions for review of mockups.
  4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### **1.3 FIELD CONDITIONS**

- A. Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

- B. Installation of gypsum board joint treatments shall not start until the space to receive gypsum board joint treatments is heated to maintain a continuous and uniform temperature of not less than 55 deg F, from one week prior to beginning of joint treatment until joint treatment is completed and thoroughly dry. Ventilation, either natural or supplied by fans, circulators or air conditioning systems shall be provided to remove excess moisture during joint treatment. Temperature requirements may be waived only on recommendation of gypsum board manufacturer.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory."
- B. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.
1. STC-Rated Assemblies: Indicated by design designations from GA-600, "Fire Resistance Design Manual."

### **2.2 MATERIALS, GENERAL**

- A. General: For fire rated assemblies, provide materials, including accessories and fasteners produced by one manufacturer, or, when products of more than one manufacturer are used in a rated system, they shall be acceptable to authorities having jurisdiction.

### **2.3 INTERIOR GYPSUM BOARD**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Gypsum.
  2. CertainTeed Corp.
  3. Georgia-Pacific Gypsum LLC.
  4. Continental Building Products/Lafarge North America Inc.
  5. National Gypsum Company.
  6. PABCO Gypsum.
  7. USG Corporation.

- B. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- C. Gypsum Board: ASTM C 1396/C 1396M.
  - 1. Type X:
    - a. Thickness: 5/8 inch.
    - b. Long Edges: Tapered.
    - c. Location: Vertical surfaces, where required for fire-resistance-rated assembly, ceilings, and where indicated on Drawings.
- D. Moisture and Mold Resistant Board: ASTM C 1396/C 1396M; with moisture- and mold-resistant core and facing surfaces.
  - 1. Core: 5/8 inch.
  - 2. Long Edges: Tapered.
  - 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
  - 4. Location: Plumbing walls, interior face of perimeter walls where gypsum board is indicated.

## 2.4 TILE BACKING PANELS

- A. Tile Backing Panels:
  - 1. Glass-Mat, Water-Resistant Backing Board (Typical): ASTM C 1178/C 1178M, with core type and in thickness indicated. Available products include:
    - a. G-P Gypsum Corp.; Dens-Shield Tile Backer.
    - b. National Gypsum Company; GOLD BOND Brand E<sup>2</sup>XP Tile Backer.
    - c. USG; Securock Glass Mat Sheathing.
- B. Cementitious Backer Units (Showers): ANSI A118.9, in thickness indicated.
  - 1. Thickness: 1/2 inch.
- C. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

## 2.5 TRIM ACCESSORIES

- A. Interior Steel Trim Accessories: ASTM C 1047; formed metal sheet steel zinc coated by hot-dipped process. Shapes indicated below by reference to Fig. 1 designations in ASTM C 1047.
  - 1. Cornerbead: Use at outside corners.

2. LC-Bead with both face and back flanges to receive joint compound; use at exposed panel edges.
  3. U-Bead with face and back flanges; face flange formed to be left without application of joint compound: Use where indicated.
  4. Expansion (Control) Joint: One-piece control joint formed with V-shaped slot, with removable strip covering slot opening. Use where indicated.
- B. Aluminum Trim Accessories: Extruded aluminum trim with 1/4 inch diameter holes in fins for attachment to gypsum board or studs; longest lengths available in profiles indicated; primed for finish painting; sized for scheduled gypsum board thickness shown.

## 2.6 JOINT TREATMENT MATERIALS

- A. General: Provide joint treatment materials complying with ASTM C 475 and the recommendations of both the manufacturers of the products and joint treatment materials for each application indicated.
- B. Joint Tape:
1. Interior Gypsum Board: Paper.
  2. Tile Backing Panels: As recommended by panel manufacturer.
  3. Paperless Gypsum Board: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
  2. Embedding and First Coat: For embedding tape and first coat on joints, flanges of trim accessories, and fasteners, use setting-type taping compound.
  3. Second Coat: For filling over tape, beads and fasteners. Use setting-type, sandable topping compound.
  4. Third Coat: For finishing over tape, beads and fasteners. Use drying-type, all-purpose compound.
  5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.
- D. Joint Compound for Tile Backing Panels:
1. Moisture/Mold-Resistant Gypsum Backing Board: Use setting-type taping and setting-type, sandable topping compounds.
  2. Cementitious Backer Units: As recommended by manufacturer.
- E. Joint Compound for Specialty Boards: As recommended by manufacturer.

## 2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

- B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90. One of the following:
1. SHEETROCK Acoustical Sealant; U.S. Gypsum.
  2. AC-20 FTR; Pecora.
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
1. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from slag wool, or rock wool.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
  2. Product: Subject to compliance with requirements, provide one of the following:
    - a. Rockwool AFB; Rockwool.
    - b. SAFB Blankets; Thermafiber LLC.
- E. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

## **PART 3 - EXECUTION**

### **3.1 APPLYING AND FINISHING PANELS**

- A. Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C 840, GA-216, and the gypsum board manufacturer's recommendations, where standards conflict, the more stringent shall apply. Install specialty gypsum board as specified below except where manufacturer's instructions conflict; follow manufacturer's instructions for specialty performance board to maintain warranty coverage.
- B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- C. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
  2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints or avoid them entirely.
    - a. Stagger abutting end joints not less than one framing member in alternate courses of board.
    - b. At high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
- D. Multilayer Application:
1. On Partitions/Walls: Apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
  2. On Ceilings: Apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply base layers in same sequence. Apply base layers at right angles to framing members and offset face layer joints one framing member, 16 inches minimum, from parallel base joints, unless otherwise indicated or required by fire-resistance-rated assembly.
- E. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- F. Multilayer Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- G. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.
- H. Tile Backing Panels:
1. Cementitious Backer Unit Application: ANSI A108.11 at showers, where substrates are indicated to receive Tile Units having a Face Dimension of Greater than 8 by 8 inches, and where otherwise indicated.
  2. Glass-Mat, Water-Resistant Backing Panel: Install with 1/4 inch gap where panels abut other construction or penetrations.
- I. Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

- J. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions.
- K. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- L. Attach gypsum panels to framing provided at openings and cutouts.
- M. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Fit gypsum panels around ducts, pipes, and conduits.
  - 2. Where partitions intersect open exterior and interior wall kickers, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by the wall kickers and other structural members; allow 1/4 to 3/8 inch wide joints to install sealant.
  - 3. Where chase walls are shown, provide bracing between parallel rows of studs. Unless otherwise shown, provide gypsum board braces no less than 1/2 inch thick by 12 inches wide and cut to width of chase. Locate at quarter points in wall height between each pair of parallel studs. Fasten with not less than 3 screws at each stud.
- N. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4 to 1/2 inch wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- O. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
- P. Cut openings in gypsum board for electrical outlets, piping and other penetrations. Maintain close tolerances so that edges will be covered by plates and escutcheons. Cut both face and back paper. Do not install electrical outlets back to back on opposing sides of partitions.
- Q. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
  - 1. Space screws a maximum of 12 inches o.c. for vertical applications.
  - 2. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.
  - 3. Install fasteners not less than 3/8 inch from ends or edges of gypsum board sheets, spacing fasteners opposite each other on adjacent ends or edges.
  - 4. Begin fastening from center of gypsum board and proceed toward edges and corners.
  - 5. Apply pressure on surface of gypsum board adjacent to fasteners being driven to ensure that gypsum board will be secured tightly to supporting members.



- a. Drive fastener with shank perpendicular to face of board.
- b. Drive screws with a power screwdriver as recommended by gypsum board manufacturer. Set heads of screws slightly below surface of paper without cutting paper.

### 3.2 INSTALLING TRIM ACCESSORIES

- A. General: Fasten trim accessories according to manufacturer's written instructions for type, length, and spacing of fasteners.
- B. Install corner beads at external corners.
- C. Install interior trim accessories where edge of gypsum panels would otherwise be exposed or semiexposed. Provide interior trim accessories with face flange formed to receive joint compound.
- D. Install aluminum trim accessories where indicated.
- E. Install control joints in locations indicated and where directed by the Architect for visual effect, or if not indicated or directed by the Architect, provide control joints in accordance with ASTM C 840 which is as follows:
  1. Where a partition, wall or ceiling traverses a construction joint (expansion, seismic, or building control element) in the base building structure.
  2. Where a wall or a partition runs in an uninterrupted straight plane exceeding 30 linear feet.
  3. Control joints in interior ceilings with perimeter relief shall be installed so that linear dimensions between control joints do not exceed 50 feet and total area between control joints does not exceed 2500 square feet.
  4. Control joints in interior ceilings without perimeter relief shall be installed so that linear dimensions between control joints do not exceed 30 linear feet and total area between control joints does not exceed 900 square feet.
  5. A control joint or intermediate blocking shall be installed where ceiling framing members change direction.

### 3.3 FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: Apply joint treatment at gypsum board joints, flanges of interior trim and aluminum trim accessories, interior angles, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration and levels of gypsum board finish indicated. Produce surfaces free of tool marks and ridges ready for decoration of type indicated. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.

- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Cementitious Backer Units: Finish according to manufacturer's written instructions.
- E. Glass-Mat, Water-Resistant Backing Panels: Do not use paper tape and joint compound. Finish according to manufacturer's written instructions.
- F. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
  - 1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
  - 2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile and where indicated.
  - 3. Level 3: Typically not used.
  - 4. Level 4 (Typical): Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.
  - 5. Level 5 (Where specifically indicated): 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 over entire surface where gypsum board is indicated to receive wall coverings, semi-gloss and high gloss paints.

**END OF SECTION**

## **SECTION 09 30 00 - TILING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes ceramic and porcelain tile.

#### **1.2 PERFORMANCE REQUIREMENTS**

- A. General: Provide floor tiles complying with the following standard and performance requirements.
- B. Dynamic Coefficient of Friction (DCOF): 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 137.1, 2012 Edition.
  - 1. Walkway Surfaces: Minimum 0.42.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each product indicated.
- B. CALgreen Submittals:
  - 1. Product Data for Section 5.504.4.1.1: For sealants, adhesives and caulks, provide documentation including printed statement of VOC content showing compliance with SCAQMD Rule 1168 VOC limits and CCR (California Code of Regulations) Title 17 for aerosols.
  - 2. Product Data for Section 5.504.4.1.2: Provide documentation for aerosol adhesives, and smaller unit sizes of adhesives, sealant, and caulking compounds (in units of product, less packaging, which do not weigh more than one (1) pound and do not consist of more than sixteen (16) fluid ounces) comply with statewide VOC standards and prohibitions on use of certain toxic compounds, of CCR Title 17, commencing with Section 94507.
  - 3. Product Data for Section 5.504.4.3: For architectural paints and coatings, provide documentation including printed statement of VOC content showing compliance with Table 1 of the ARB, Architectural Coatings Suggested Control Measure, unless more stringent local limits apply.
  - 4. Product Data for Section 5.504.4.3.1: Aerosol paints and coatings, provide documentation that products meet the PWMIR Limits for ROC in Section 94522 (a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Section 94522(c)(2) and (d)(2) of CCR Title 17.

- C. Shop Drawings: Submit shop drawings showing the extent of each type of movement joint. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- D. Samples: Submit samples showing full range of color and texture variations expected.
  - 1. Full size units of each type, composition, color, and finish of tile. Submit at least three samples of each tile proposed. Where tile size is smaller than 6- by-6-inches, submit sample boards a minimum of 12-by-12-inches showing variation of color and finish.
  - 2. Assembled samples with grouted joints for each color grout and for each type, composition, color, and finish of tile. Minimum size 12-by-12-inches or 3 full tiles.
  - 3. Thresholds in 6-inch lengths, each type.
  - 4. Metal edge strip in 6-inch lengths, each type.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Test Reports: Submit test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of tile products with requirements specified for slip resistance.
- B. Master Grade Certificates: Submit master grade certificates for each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: Submit manufacturer's certifications for each type of grout and bonding material being provided suitable for the intended use and meet or exceed the referenced standards and the requirements of this Specification.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Instructions: Submit maintenance instructions for each type of product specified.

#### **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Provide attic stock equal to the following for each type, color, pattern, and size (or fraction thereof) of tile provided for the Project. Supply in manufacturer's unopened containers, identified with name, brand type, grade, class and all other qualifying information, to a location where directed by the Owner.
  - 1. Two percent of amount installed but not less than one box.

#### **1.7 QUALITY ASSURANCE**

- A. Installer: Engage an installer, with a minimum of 5 years of successful commercial tile installations similar in material, design, and scope to that indicated.

- B. Source Limitations for Tile: Obtain tile from one source or producer, and from same production run, and of consistent quality in appearance and physical properties for each contiguous area.
- C. Field-Constructed Sample Installations: Before installing tile, erect sample installations for each form of construction and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build sample installations to comply with the following requirements, using materials indicated for final unit of Work.
  - 1. Locate sample installations on site, in locations and size indicated or, if not shown or indicated, as directed by Architect but not less than 100 sq. ft. area for floors, and not less than 100 sq. ft. area for walls.
  - 2. Retain and maintain sample installations during construction in undisturbed condition as a standard for judging completed unit of Work.
  - 3. Approved sample installations may become part of the completed Work if undisturbed at time of Substantial Completion.

## **1.8 DELIVERY STORAGE AND HANDLING**

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.
- B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

## **1.9 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.
- B. Maintain temperatures within range recommended by the mortar and grout manufacturer, but not less than 50 deg F or more than 90 deg F, in spaces during tile setting. After installation maintain temperatures within range recommended by the mortar and grout manufacturer
- C. Close spaces to traffic during tile flooring installation.
- D. Close spaces to traffic for 72 hours after tile flooring installation.
- E. Shade all tile, materials and the work area from direct sunlight during the installation as needed to prevent rapid evaporation caused by excessive heat or wind.

## PART 2 - PRODUCTS

### 2.1 TILE PRODUCTS, GENERAL (TL##)

ANSI Ceramic Tile Standard: Provide 'Standard Grade' tile that complies with ANSI A137.1 "Specifications for Ceramic Tile," ANSI A137.2, "Specifications for Glass Tile," ANSI A137.3, "Specifications for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs" for types, compositions, and other characteristics indicated.

- A. Products and Manufacturers: Provide tile matching the Architect's samples which have been selected from the product lines and manufacturers indicated in Finish Schedule on Drawings.
- B. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.
- C. Tile Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing where applicable.
- D. Rectified Tile Edges: Provide all tile units having a face dimension of greater than 8" x 8" with factory rectified edges.

### 2.2 ACCESSORY MATERIALS

- A. Thresholds: Fabricate to provide transition between adjacent floor finishes. Bevel edges at 1:2 slope, limit height of bevel to 1/2 inch or less, and finish bevel to match face of threshold.
  - 1. Marble Thresholds: ASTM C 503 with a minimum abrasion resistance of 12 per ASTM C 1353 or ASTM C 241 and with honed finish.
    - a. Description: Uniform, fine- to medium-grained white stone with gray veining.
- B. Waterproofing for Toilet Room Installations:
  - 1. Fabric-Reinforced and Unreinforced Fluid-Applied Product: System consisting of liquid-latex rubber, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), and fabric reinforcement which are compatible with mortar bed specified and complying with ANSI A118.10; one of the following:
    - a. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane. which is manufactured in the plant closest to the geographic location of the project.
    - b. LATICRETE International Inc.; Laticrete 9235 Waterproof Membrane. which is manufactured in the plant closest to the geographic location of the project.
    - c. MAPEI Corporation; Mapelastic AquaDefense, which is manufactured in the plant closest to the geographic location of the project.
    - d. Ardex; Ardex 8+9 which is manufactured in the plant closest to the geographic location of the project.

2. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional regulations as shown in CALgreen Section 5.504.4.1.
3. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds shall comply with regulations as shown in CALgreen Section 5.504.4.2.
4. Paints and coatings shall comply with VOC content as shown in CALgreen Section 5.504.4.3.

C. Crack Isolation Membrane for Tile Installations:

1. Fabric-Reinforced, Fluid-Applied Product: System consisting of liquid-latex rubber, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24) (ASTM D 3960), and fabric reinforcement which are compatible with mortar bed specified and complying with ANSI A118.12; one of the following:
  - a. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane. which is manufactured in the plant closest to the geographic location of the project.
  - b. LATICRETE International Inc.; Laticrete 9235 Waterproof Membrane,. which is manufactured in the plant closest to the geographic location of the project.
  - c. MAPEI Corporation; Mapelastic AquaDefense, which is manufactured in the plant closest to the geographic location of the project.
2. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional regulations as shown in CALgreen Section 5.504.4.1.
3. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds shall comply with regulations as shown in CALgreen Section 5.504.4.2.
4. Paints and coatings shall comply with VOC content as shown in CALgreen Section 5.504.4.3.

## 2.3 SETTING AND GROUTING MATERIALS

- A. Manufacturers and Plant Locations: Provide products manufactured in the plant closest to the geographic location of the project.
- B. Source Limitations: For each tile installation, obtain compatible formulations of setting and grouting materials and waterproofing materials containing latex or latex additives from a single manufacturer.
- C. Latex-Portland Cement Mortar (Thin Set):
  1. Prepackaged dry-mortar mix combined with dry powder latex additive, the following:
    - a. For Thin Set Placed over Slabs on Grade: Complying with ANSI A118.4 one of the following:
      - 1) Ultraflex 2 Mortar; MAPEI Corporation.
      - 2) Laticrete 253 Gold; Laticrete International Inc.

- 3) Versabond Flex; Custom Building Products.
- b. For Thin Set Tile Set over Walls, Membranes and Over Elevated Slabs:  
Complying with ANSI A118.15, one of the following:
  - 1) Kerabond Keralastic; MAPEI Corporation.
  - 2) Laticrete 272 mixed with Laticrete 333 Superflex; Laticrete International Inc.
2. For wall applications, provide nonsagging mortar.
- D. Dry Set Mortar for Large and Heavy Tile (LHT Mortar): Complying with ANSI A118.4:
  1. Prepackaged dry-mortar mix combined with additives to minimize slump and facilitate a thicker bond coat, and specifically manufactured and recommended in writing by the mortar and underlayment manufacturer for use in LHT mortar assemblies; one of the following:
    - a. Ultraflex LFT Mortar; MAPEI Corporation.
    - b. Laticrete 4-XLT; Laticrete International Inc.
- E. Polymer-Modified Tile Grout (For Typical Applications): Complying with ANSI A118.7 compounded with calcium aluminate cement, non-shrinking, efflorescence free grout. Provide, and stockpile, grout for each exposed color from a single manufactured and packaged batch source for the entire Project.
  1. Polymer Type: Dry, redispersible latex/polymer powder form, prepackaged with other dry ingredients, one of the following:
    - a. Prism; Custom Building Products.
    - b. Permacolor; Laticrete International Inc.
    - c. Ultracolor Plus FA; Mapei Corporation.
  2. Colors: As selected by Architect from manufacturers standards to match tile being grouted.
- F. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional regulations as shown in CALgreen Section 5.504.4.1.
- G. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds shall comply with regulations as shown in CALgreen Section 5.504.4.2.
- H. Paints and coatings shall comply with VOC content as shown in CALgreen Section 5.504.4.3.

## 2.4 MISCELLANEOUS MATERIALS

- A. Joint Sealants:



1. Typical Surfaces: "Mildew-Resistant Silicone Sealant", as specified in Section 07 92 00 "Joint Sealants."
  2. Floor Joints: "Two-Part Polyurethane Sealant for Paving Applications," as specified in Section 07 92 00 "Joint Sealants."
- B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- C. Grout Sealer: Grout manufacturers recommended product for sealing cementitious grout joints and that does not change color or appearance of grout.
- D. Underlayment Product for Leveling and Patching Floors indicated to receive Tiles: Latex-modified, cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
1. Either Ultraplan or Novaplan Underlayment; MAPEI Corporation.
  2. NXT Level Plus Underlayment; Laticrete International Inc.
- E. Metal Edge Strips for Wall Applications: Metallic, angle or L-shaped, depth to match tile and setting-bed thickness and having an integral provision for anchorage to substrate; aluminum alloy exposed-edge material; furnish in longest lengths available.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Blanke Corporation.
    - b. Ceramic Tool Company, Inc.
    - c. Schluter Systems L.P.
- F. Divider, Transition, and Movement Joint Strips:
1. Divider and Transition Strips: Stainless steel shapes and flat bar trims fabricated from ASTM A 666 (for flat bar) and ASTM A 276 (for shapes) Type 304 stainless steel, 1/4 inch wide at top edge unless otherwise indicated, depth as required to suit conditions shown and having an integral provision for anchorage to mortar bed or substrate, unless otherwise indicated. Provide NAAMM #4 satin finish at exposed top edge in the long direction, furnish in longest lengths available.
  2. Movement Joint Strips: Laminations of extruded aluminum or formed stainless steel angle shapes, depth as required to finish flush with top surface of adjacent tile flooring fields, back to back installed with full height flexible filler to accommodate movement. Control joints shall have either an exposed approximately 5/8 inch wide interlocking continuous top to conceal prefabricated flexible filler or an exposed custom flexible prefabricated filler to accommodate movement. Joint assembly shall have a total movement capability of approximately 1/4 + 1/8 inch/-3/32 /inch. Finish of exposed top to be satin. One of the following:
    - a. Basis of Design: Emseal Series ESF 16 AL; Emseal Joint Systems, Ltd.

- b. Schluter; Dilex - EDP, fabricated to comply with the specified requirements.
  - c. CTC (Ceramic Tool Company); CTC Joint custom fabricated to comply with the specified requirements.
  - d. Vexcolt; Ti-Lock Metal, TAM NL 42151 (for thickset) or TAM NA 1212 (for medium and thinset).
- G. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional regulations as shown in CALgreen Section 5.504.4.1.
- H. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds shall comply with regulations as shown in CALgreen Section 5.504.4.2.
- I. Paints and coatings shall comply with VOC content as shown in CALgreen Section 5.504.4.3.

## 2.5 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions. Add materials and liquid latex additives in accurate proportions. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present.
- 1. Verify that substrates for setting tile are sound and free of voids, bugholes, rock pockets, honeycombs, and protrusions, and which are dry, clean, free of oil, waxy films, and curing compounds. Grind or scarify concrete substrates to remove existing floor adhesive and mortar residues (if any), laitance, films, sealing and curing compounds if they are determined to be present on the substrate.
  - 2. 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 before installing tile.
  - 3. Verify that joints and cracks in the existing floor substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
  - 4. Do not commence installation of flooring materials until floor substrate is within the following tolerances in all directions. If substrate is not within tolerance, level the substrate using a method and an underlayment product(s) that is compatible with and acceptable to the setting materials manufacturer.
    - a. Subfloor Surfaces to Receive Thinset and LHT Mortar Setting Beds: +/- 1/8 inch in 10 feet
    - b. Subfloor Surfaces to Receive Thickset Setting Beds: +/- 1/4 inch in 10 feet No valleys or ridges greater than 1/8 inch

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove paint, coatings, including curing compounds and other substances that are incompatible with tile-setting materials.
- B. Blending: Color blend tiles at Project site before installing.
  - 1. Furnish the same lots, batches, etc. within the same contiguous areas of the site (i.e. corridors on the same floors, common rooms which adjoin each other, etc.).

### 3.3 INSTALLATION, GENERAL

- A. Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" and the TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" that apply to types of setting and grouting materials and to methods indicated.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area beginning at thresholds. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.
  - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
- E. Finished Surfaces: Unless otherwise accepted in the sample installation(s), if any, finished surfaces shall present a flat, even appearance, free from waver, projections, and depressions.
- F. Movement (Contraction, Control, Expansion, and Isolation Joints) Joints: Locate sealant filled movement joints where recommended by the manufacturer of mortar and grout materials, but not less than the requirements of TCNA EJ171 which follows, and as accepted by the Architect. Form movement joints and other sealant-filled joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles. Where movement joints are to be butted, the ends shall touch and align.
  - 1. Spacing Guidelines:

- a. 20 to 25 feet in each direction where interior tile work is not exposed to direct sunlight or moisture.
  - b. 8 to 12 feet in each direction where interior tile work is exposed to direct sunlight and moisture.
  - c. Where tilework abuts restraining surfaces such as perimeter walls, dissimilar floors, curbs, columns, pipes, ceilings, and where changes occur in backing materials, but not at drain strainers.
  - d. In the joint between tiles making up the inside corner of planes.
  - e. All contraction, control, expansion, isolation, seismic and cold joints in the horizontal structure and vertical surfaces shall continue through the tile surfaces, but not through membranes.
  - f. Vertical and Horizontal Joints Widths: Widths for quarry tile and paver tile shall be the same as the grout joint but not less than 1/4 inch or the width of the contraction, control, expansion, seismic, isolation joint whichever is greater; widths for ceramic mosaic tile and glazed wall tile shall not be less than 1/8 inch or the width of the control, expansion, seismic, joint whichever is greater.
  - g. Keep movement joints free from dirt, debris, grout, mortar, and setting bed materials. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."
- G. Metal Edge Strips: Install where exposed edge of wall tile meets other wall finishes that finish flush with or below face of tile and the manufacturer of the field tile does not manufacture a tile edge transition trim. Where metal edge strips are indicated and full length single units are not available, joints are to be butted, ends shall touch and align.
- H. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout sealer manufacturer's written instructions. As soon as sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

### **3.4 WATERPROOFING INSTALLATION**

- A. Install waterproofing to comply with ANSI A108.13 and waterproofing manufacturer's written instructions to produce waterproof membrane of uniform thickness bonded securely to substrate.
1. Do not install tile over waterproofing until waterproofing has cured, and at each horizontal installation, has been tested for water tightness. Test waterproofing membrane for watertightness by damming the floor drain, and creating a dam at the perimeter of the waterproofed basin followed by filling the basin with water, marking the height, and verifying the same height after 48 hours. Repair leaks before continuing with the installation of subsequent tile.

### **3.5 CRACK ISOLATION MEMBRANE INSTALLATION**

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

1. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

### 3.6 FLOOR TILE INSTALLATION

- A. Thinset Tile over Concrete Slabs (Typical ): Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for setting bed methods, installation methods related to types of subfloor construction, and grout installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.
1. Mortar: Latex-Portland Cement Mortar: ANSI A108.5.
  2. Concrete Subfloors, Interior: TCNA F113.
    - a. With a trowel, having notches sized as recommended by the mortar manufacturer, comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturer's recommendations.
    - b. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.
    - c. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100 percent coverage to thickness of not less than 1/16-inch.
    - d. Place tiles onto mortar bed, maintaining 1/8-inch wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using damp sponge. Rake out joints to depth required to receive grout as tile units are set.
    - e. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.
  3. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. For typical installations, comply with latex-portland cement: ANSI A108.10; grout installation for kitchen installations, epoxy grout: ANSI A108.6. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.
- B. Thinset Tile over Waterproof Membrane (Toilet Rooms): Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for setting bed methods, installation methods related to types of subfloor construction, and grout installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.
1. Mortar: Latex-Portland Cement Mortar: ANSI A108.5.
  2. Concrete Subfloors, Interior: TCNA F122 (on ground) and F122A (above ground).
    - a. Apply the mortar to waterproofed slab with the flat side of the trowel.

- b. With a trowel, having notches sized as recommended by the mortar manufacturer, comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturer's recommendations.
  - c. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.
  - d. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100 percent coverage to thickness of not less than 1/16-inch.
  - e. Place tiles onto mortar bed, maintaining 1/8-inch wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using damp sponge. Rake out joints to depth required to receive grout as tile units are set.
  - f. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.
3. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. For typical installations, comply with latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.
- C. Thinset Tile over Crack Isolation Membrane: Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for setting bed methods, installation methods related to types of subfloor construction, and grout installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.
1. Mortar: Latex-Portland Cement Mortar: ANSI A108.5.
  2. Concrete Subfloors, Interior: TCNA F125-Full.
    - a. Apply the mortar to crack isolation membrane covered slab with the flat side of the trowel.
    - b. With a trowel, having notches sized as recommended by the mortar manufacturer, comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturer's recommendations.
    - c. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.
    - d. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100 percent coverage to thickness of not less than 1/16-inch.
    - e. Place tiles onto mortar bed, maintaining 1/8-inch wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using damp sponges. Rake out joints to depth required to receive grout as tile units are set.

- f. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.
3. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. Comply with Latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.
- D. LHT Set Tile (Only where indicated): Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for setting bed methods, installation methods related to types of subfloor construction, and grout installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.
1. Mortar: Latex-Portland Cement Mortar: ANSI A108.5.
  2. Concrete Subfloors, Interior: TCNA F205 (on-ground slabs) and TCNA F205A (above ground slabs) except apply LHT bed in thickness of 3/4" unless otherwise indicated.
    - a. Where required by the conditions indicated, apply underlayment using methods and within time limits recommended by the mortar manufacturer.
    - b. With a trowel, having notches sized as recommended by the mortar manufacturer, place and comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturers recommendations.
    - c. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.
    - d. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100% coverage to thickness of not less than 1/16-inch.
    - e. Place tiles onto mortar bed, maintaining 1/8-inch wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using damp sponges. Rake out joints to depth required to receive grout as tile units are set.
    - f. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.
  3. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. Comply with Latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.
- E. Stone Thresholds: Install stone thresholds in one piece, notched to fit neatly at door jambs; set in same type of setting bed as abutting field tile in accordance with TCNA Method TR611.

### 3.7 WALL TILE INSTALLATION

- A. Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for ANSI setting bed methods, TCNA installation methods related to types of construction, and grout ANSI installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.
1. Latex Portland Cement Mortar Installation (using specified latex portland cement mortar material): ANSI A108.5.
  2. Gypsum Wallboard, Interior (Latex Portland Cement Mortar) Method: TCNA W243, place tiles maintaining 1/8-inch wide joints, and true accurate pattern as shown.
  3. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. Comply with Latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.

### 3.8 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all tile surfaces so they are free of foreign matter.
1. Remove grout residue from tile as soon as possible.
  2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
- B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work. Replace all cracked, chipped, and broken tile units with matching tile units; patched tile units will not be permitted.
- C. 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.
- D. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

### END OF SECTION



## SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for ceilings.

#### 1.2 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: Submit product data for each type of product indicated.
- B. Shop Drawings: Submit shop drawings of reflected ceiling plans drawn accurately to large scale and coordinating penetrations and ceiling-mounted items. Show the following:
  - 1. Patterns of ceiling suspension assembly members with setting out/work points.
  - 2. Method of attaching hangers to building structure.
  - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
- C. Samples: Submit samples for each acoustical panel, for each exposed suspension system member, for each exposed molding and trim, and for each color and texture required, prepared on Samples of size indicated below. Samples shall show the full range of color and texture variations to be expected in the final installation.
  - 1. Acoustical Panel: Set of 6-inch square Samples of each type, color, pattern, and texture.
  - 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch long Samples of each type, finish, and color.
- D. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish and store at the site where directed, 2 percent of each type of acoustic panel installed in the Project, packaged in manufacturer's unopened cartons and identified as to contents.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an Installer, with not less than 5 years experience in the installation of materials specified, and who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

## 1.6 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 a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

## 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until wet work (painting, drywall, interior tilework, and concrete leveling) in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of Seismic Zone 4 earthquake motions according to the following:
  - 1. CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4."
- B. Performance Requirements: Basis of Design ceiling panels and suspension systems are scheduled on Drawings. If comparable products are proposed, submit only those products and systems capable of acoustical performance equivalent to the products and systems scheduled.

- C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: Class A according to ASTM E 1264.
  - 2. Smoke-Developed Index: 50 or less.

## 2.2 METAL SUSPENSION SYSTEMS

- 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.
- B. Overhead Deck Hanger Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.
  - 1. Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with eyepins, 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 assembly.
- C. Hangers: As follows:
  - 1. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
    - a. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 12 gage (0.106-inch) diameter wire.
- D. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, 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, finish, and color as that used for exposed flanges of suspension system runners; provide in longest standard single piece lengths.
  - 1. Shadow (Stepped Moldings): Stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member. Form from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.
- E. Clips: Provide support clips, clamps, fasteners, splines, and other attachment devices as required to align components and to connect components and transfer imposed loads of suspension system.
  - 1. Provide partition attachment clips, and fasteners for areas where partition ceiling runners are secured to the ceiling suspension system.
  - 2. Provide attachment clips for runner to angle molding to avoid use of pop rivets.

3. Provide grid converter accessories as required to change main tee direction 90 degrees from adjacent main tee.
  4. Provide light fixture clips.
  5. Provide hold down clips at entryways to reduce flutter as required.
  6. Provide miter closure clips.
  7. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
  8. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.
- F. Manufacturers and Products: Refer to drawings and schedules for extent and types of each metal suspension system required.
1. Subject to requirements, provide scheduled suspension systems, or comparable products, acceptable to the Architect, by one of the following:
    - a. Armstrong World Industries, Inc.
    - b. CertainTeed Corporation.
    - c. Chicago Metallic Corporation.
    - d. United States Gypsum Company.

### **2.3 ACOUSTICAL PANELS (CL##)**

- A. Manufacturers and Products: Refer to drawings and schedules for extent and types of each acoustical panel required.
1. Subject to requirements, provide scheduled acoustical panels, or comparable products, acceptable to the Architect, by one of the following:
    - a. Armstrong World Industries, Inc.
    - b. CertainTeed Corporation.
    - c. Chicago Metallic Corporation.
    - d. Rockfon (Roxul Inc.).
    - e. United States Gypsum Company.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation, anchorage, with requirements for installation tolerances, and other conditions affecting performance of acoustical panel ceilings.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Layout the Work to center board pattern both directions around Work points shown in each major space or room as shown on the Drawings or directed and, where possible, adjust pattern so that edge pieces will be not less than 1/2 unit in width.

### 3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook," and as required to match the accepted sample installation.
- B. Suspend ceiling hangers as follows:
1. Fasten hangers to anchors that extend into decks. Space hangers not more than 48 inches long each member supported directly from hangers; and provide hangers not more than 6 inches from ends of each member. Provide additional hangers for support of fixtures and other items including but not limited to light fixtures and diffusers, as required to prevent overloading of deck attachment, eccentric deflection or rotation of supporting runners.
  2. Hangers:
    - a. Secure wire hangers to ceiling suspension members and to supports above with a minimum of 3 tight turns. Connect hangers directly to drilled in anchors (eye screws), or other devices that are secure, and are appropriate for substrate.
  3. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  4. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of the supporting structure or of the ceiling suspension system.
  5. 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 referenced standards and publications.
  6. Lateral Force Bracing:

- a. Horizontal restraints shall be provided by four No. 12 gage wires secured to the main runner within 2 inches of the cross runner intersection and splayed 90 degrees from each other at an angle not exceeding 45 degrees from the plane of the ceiling. A strut fastened to the main runner shall be extended to and fastened to the structural members supporting the roof or floor above. The strut shall be adequate to resist the vertical component induced by the bracing wires. These horizontal restraint points shall be placed not more than 12 feet on center in both directions with the first point within 6 feet from each wall. Attachment of the restraint wires to the structure above shall be adequate for the load imposed.
  - b. Lateral force bracing members shall be spaced a minimum of 6 inches from all horizontal piping or ductwork that is not provided with bracing restraints for horizontal forces. Bracing wires shall be attached to the grid and to the structure in such a manner that they can support a design load of not less than 200 pounds or the actual design load, whichever is greater, with a safety factor of 2.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Typical Edge Molding Attachment: Align moldings accurately and screw attach securely to substrate with concealed fasteners at intervals not more than 16 inches on center and not more than 3 inches from ends, leveling with ceiling suspension system. Miter corners accurately and connect securely.
    - a. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension system runners so they are square and securely interlocked with one another. Clip runners to angle moldings do not use exposed fasteners. Finish to lines and levels shown, with maximum deflection not to exceed  $1/360$  of the span between supports. Laser level accurately in all directions, leveling to a tolerance of  $1/8$ -inch noncumulative. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Run grain of units in one direction as accepted on shop drawings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
  2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
  3. 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.
  4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using sealer and coating recommended in writing for this purpose by acoustical panel manufacturer.

### **3.4 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.

**END OF SECTION**

## **SECTION 09 61 23 - CONCRETE FLOORING TREATMENT**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

A. Section includes concrete sealing compound for the following applications:

1. New concrete floor to remain exposed.

#### **1.2 ACTION SUBMITTALS**

A. Product Data: Submit manufacturer's specifications, VOC content, application instructions, and general recommendations. Include data substantiating that products to be furnished comply with requirements of the contract documents.

B. CALgreen Submittals:

1. Product Data for Section 5.504.4.3: For architectural paints and coatings, provide documentation including printed statement of VOC content showing compliance with Table 1 of the ARB, Architectural Coatings Suggested Control Measure, unless more stringent local limits apply.
2. Product Data for Section 5.504.4.3.1: Aerosol paints and coatings, provide documentation that products meet the PWMIR Limits for ROC in Section 94522 (a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Section 94522(c)(2 and (d)(2) of CCR Title 17.

#### **1.3 CLOSEOUT SUBMITTALS**

A. Maintenance Data: Submit manufacturer's instructions for proper maintenance materials and procedures.

#### **1.4 QUALITY ASSURANCE**

A. Regulatory Requirements:

1. Accessibility Requirements: Comply with applicable provisions of the following:
  - a. U.S. Architectural and Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities (ADAAG).
  - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.

B. Manufacturer Qualifications: Provide products produced by a company that has successfully specialized in production of this type of work for not less than 5 years.



## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers with seals unbroken and bearing manufacturer's labels.
- B. Store materials in a clean, dry location protected from exposure to direct sunlight. In storage areas, maintain environmental conditions within range recommended in writing by manufacturer.

## 1.6 FIELD CONDITIONS

- A. Environmental Requirements: Do not proceed with installation until areas to receive the work have been enclosed and until temperature and relative humidity have been stabilized and will be maintained within values established by the manufacturer for optimum quality control.
- B. Environmental Limitations: Comply with coating manufacturer's written instructions for substrate temperature, ambient temperature, humidity, ventilation, and conditions affecting floor treatment application. Do not apply coating until wet work in spaces is complete and dry; and overhead work, including installation of mechanical systems, and lighting is complete.
  - 1. Apply floor coatings when substrate temperature and surrounding air temperatures are between 50 deg F and 95 deg F.
- C. Do not apply floor coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
- D. Ventilation: Provide adequate ventilation to prevent accumulation of hazardous fumes, if any, during application of concrete floor sealer in enclosed spaces, and maintain ventilation until sealer has cured.

## PART 2 - PRODUCTS

### 2.1 SEALING COMPOUND

- A. Clear, Waterborne, Membrane-Forming Sealing Compound: ASTM C 1315, Type 1, Class A or B.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Master Builder Solutions by BASF; MasterKure CC 1315WB.
    - b. The Euclid Chemical Company; Super Aqua-Cure VOX.
  - 2. Paints and coatings shall comply with VOC content as shown in CALgreen Section 5.504.4.3.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates for conditions affecting performance and conditions of floor treatment with requirements for maximum moisture content. Verify concrete slabs are flat, level, and dry.
  - 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter for concrete: 12 percent.
  - 2. Verify compatibility with and suitability of substrates, including existing finishes or primers. Verify if plasticizers in existing concrete substrate will not impair bond.
  - 3. Perform tests recommended by manufacturer. Proceed with installation after substrates pass testing.
  - 4. Commence coating application after unsatisfactory conditions are corrected and surfaces are dry.
  - 5. Commencement of floor treatment application indicates acceptance of surfaces and conditions.

### **3.2 PREPARATION**

- A. Clean substrate, removing projections and substances detrimental to the work; comply with recommendations of manufacturer for preparation procedures. Mask off or protect adjacent surfaces not scheduled to receive sealer.
- B. Concrete Substrates: Prepare and clean substrates according to manufacturer's written instructions.
  - 1. Clean substrates of substances that impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants. Neutralize plasticizers that cannot be removed.
  - 2. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
  - 3. Remove incompatible primers and reprime substrate with compatible primers as required
  - 4. Remove laitance, glaze, curing compounds, form release agents, dust, dirt, grease, oil, and contaminants that impair bond. Remove contaminants using mechanical means.
  - 5. Treat nonmoving substrate cracks and control joints to prevent cracks from telegraphing (reflecting) through flooring according to manufacturer's written recommendations.
  - 6. Protect substrate voids and joints to prevent flooring resins from flowing into or leaking through them.
- C. Protect walls, floor openings, equipment inserts, electrical openings, door frames, and obstructions during installation. Cover floor and wall areas at mixing stations.

### **3.3 APPLICATION**

- A. General: Comply with manufacturer's instructions, except where more stringent requirements are shown or specified, and except where Project conditions require extra precautions or provisions to ensure satisfactory performance of the Work.
- B. Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### **3.4 CLEANING**

- A. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or appropriate methods for coating. Do not scratch or damage adjacent finished surfaces.

### **3.5 PROTECTION**

- A. Institute protective procedures and install protective materials as required to ensure that work is without damage or deterioration at substantial completion. Protect adjacent work against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities and before Substantial Completion, touch up and restore damaged or defaced coated surfaces.

**END OF SECTION**

## **SECTION 09 61 29 - PROCESSED CONCRETE FLOOR FINISHES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

A. Section includes:

1. Grinding, honing and polishing of concrete floor slabs.
2. Application of penetrating hardener/densifier.
3. Accessories necessary for a complete installation.

B. Related Requirements:

1. Section 03 30 00 "Cast-In-Place Concrete."
2. Section 09 61 23 "Concrete Flooring Treatment" for applications of concrete sealer on slabs not indicated to receive ground or polished finishes.

#### **1.2 DEFINITIONS**

- A. Ground Concrete: Concrete ground with bonded abrasives utilizing up to a 50-grit resin.
- B. Densifier: Chemical treatment applied to concrete after grinding and initial honing.
- C. Honed Concrete: Concrete ground with a series of bonded abrasives, ending with abrasives between a 100-grit resin and a 400-grit resin.
- D. Polished Concrete: Concrete ground with a series of bonded abrasives, beginning with approximately an 800-grit resin and ending with an 800-grit resin.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Dynamic Coefficient of Friction: For polished concrete walkway surfaces, provide finished installation with the following values as determined by testing identical installations by the DCOF AcuTest Method per ANSI 137.1, 2012 Edition:
1. Walkway Surfaces: Minimum 0.42.

#### **1.4 SUBMITTALS**

- A. Product Data: Submit manufacturer's specifications, application instructions, and general recommendations. Include data substantiating that products to be furnished comply with requirements of the contract documents.

- B. Sustainable Design Submittals: Refer to Division 01 Section "Sustainable Design Requirements."
- C. Applicator Qualifications: Submit documentation showing applicator has a minimum of 5 years documented experience in the application of polished concrete floor finishes.
- D. Test Reports: Submit finished floor gloss test reports from a qualified independent Testing Laboratory.

## 1.5 QUALITY ASSURANCE

- A. Mockup: Prior to commencement of the work of this Section, prepare field mockup for evaluation of surface preparation techniques and application workmanship.
  - 1. Location and Size: Prepare 10 foot by 10 foot mockup for system specified, using same materials, tools, equipment, and procedures intended for actual surface preparation and application in location determined by the Architect.
  - 2. Notify Architect minimum 7 days prior to date and time when mockup will be prepared.
  - 3. Demonstrate proposed range of aesthetic effects and workmanship, including edge work.
  - 4. Obtain Architect's approval of mockup before proceeding with work.
  - 5. Maintain mockup during construction in undisturbed condition as a standard for judging completed work.
- B. Comply with the requirements for bonded abrasive polished concrete floors published by the Concrete Polishing Council.
- C. Pre-application Meeting: Conduct a meeting before start of concrete processing. Require attendance of entities directly affecting work, including Owner's Representative and Certified Applicator. Review the following:
  - 1. Environmental requirements.
  - 2. Scheduling and phasing of work.
  - 3. Coordination with other work and personnel.
  - 4. Protection of adjacent surfaces.
  - 5. Surface preparation.
  - 6. Repair of defects and defective work.
  - 7. Cleaning.
  - 8. Application of floor finish.
  - 9. Field quality control methods.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers with seals unbroken and bearing manufacturer's labels.

- B. Store materials in a clean, dry location protected from exposure to direct sunlight. In storage areas, maintain environmental conditions within range recommended in writing by manufacturer.

## **1.7 FIELD CONDITIONS**

- A. Environmental Requirements: Do not proceed with installation until areas to receive the work have been enclosed and until temperature and relative humidity have been stabilized and will be maintained within values established by the manufacturer for optimum quality control.
- B. Ventilation: Provide adequate ventilation to prevent accumulation of hazardous fumes, if any, during concrete processing in enclosed spaces, and maintain ventilation until application is complete.

## **PART 2 - PRODUCTS**

### **2.1 PRODUCTS AND MATERIALS**

- A. Basis-of-Design Densifier: As scheduled on Drawings.
- B. Subject to requirements, provide the basis-of-design densifier, or a comparable product, acceptable to the Architect, by one of the following:
  - 1. Ameripolish.
  - 2. Curecrete Chemical Company Inc.
  - 3. Dayton Superior Chemical.
  - 4. Euclid Chemical Company.
  - 5. Green Umbrella Architectural Concrete Systems.
  - 6. L & M Construction Chemicals Inc.
  - 7. Vexcon Chemicals, Inc.
- C. Floor Finishing Material: Provide a clear liquid silicate hardener/densifier capable of permanently sealing, dustproofing, and hardening concrete surfaces and providing abrasion resistance by chemically reacting with concrete to penetrate into concrete pores, leaving no surface film or residue. Products containing silicates are not permitted.

### **2.2 ACCESSORY MATERIALS**

- A. Floor Cleaner: Type recommended by densifier manufacturer.
- B. Neutralizing Agents: Trisodium phosphate or ammonia necessary for neutralizing acid spills and for cleaning concrete substrate. Provide items in accordance with floor finish manufacturer's instructions, including thinners.

- C. Joint Filler: Epoxy filler and polyurea sealant, VOC compliant, non-staining, compatible with floor finish and recommended by floor finish manufacturer.
- D. Polishing Accessories: Polishing pads recommended by floor finishing manufacturer for application.
- E. Sealer: Densifier manufacturer's standard protective sealer.
- F. Equipment: Recommended by densifier manufacturer.
  - 1. Scrubbing: Head pressure of 150 lbs. , unless otherwise recommended by floor finishing manufacturer.
  - 2. Grinding: Counter rotating head floor grinding machine and edge grinder.
  - 3. Dust extraction system: Manufacturer's standard.
  - 4. Grinding Heads: Metal bonded or resin bonded, applicable for application to achieve specified finish level.
  - 5. Grinding Pads: Recommended by equipment manufacturer to achieve specified finish level.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Inspect substrates and conditions under which the Work of this Section will be performed, and verify that installation properly may commence. Do not proceed with the Work until unsatisfactory conditions have been resolved fully.

#### **3.2 PREPARATION**

- A. Prior to application, scrub floor with recommended floor cleaner to remove latent salts. Verify floor is free of curing membrane, bond breaker, and construction laitance. Do not proceed with the work until unsatisfactory conditions have been corrected.
- B. Close areas to traffic during and after floor finish application for time period recommended by manufacturer. Protect surrounding and adjacent surfaces in accordance with floor finish manufacturer's written recommendations. Do not apply tape to floor.

#### **3.3 APPLICATION**

- A. General: Comply with manufacturer's instructions, except where more stringent requirements are shown or specified, and except where Project conditions require extra precautions or provisions to ensure satisfactory performance of the Work.
- B. Grind concrete with bonded abrasives utilizing up to a 50-grit resin.

1. Grind protrusions flush with surface, removing floor slab imperfections and imparting uniform scratch pattern in concrete surfaces.
  2. Clean floor thoroughly before proceeding with the next grit.
- C. Hone concrete starting with approximately 100-grit resin.
1. Thoroughly vacuum floor using a squeegee vacuum attachment to remove dust and debris.
- D. Apply hardener/densifier material no later than 200-grit resin, at manufacturer recommended rates. Remove excess hardener from surface and allow to cure between coats. Provide two coats before continuing honing operations.
- E. Continue honing through approximately 400-grit resin. Remove scratches from previous steps.
1. Thoroughly vacuum floor using a squeegee vacuum attachment to remove dust and debris.
- F. Polish concrete starting with approximately 800-grit resin. Remove scratches from previous steps. Continue polishing with progressively finer grits, up through at least 800-grit resin. Provide a consistent polished surface with a medium gloss appearance.
1. Thoroughly vacuum floor using a squeegee vacuum attachment to remove dust and debris.

### **3.4 FINAL CONCRETE FLOOR FINISH**

- A. Provide the following final class of concrete floor finish:
1. Class B: Fine Aggregate (Salt and Pepper) Finish: Remove not more than 1/16 inch of concrete surface by grinding and polishing resulting in majority of exposure displaying fine aggregate with no, or small amount of, medium aggregate at random locations.
- B. Provide the following final gloss level of concrete floor finish:
1. Level 2 - Medium Gloss Appearance:
    - a. Procedure: Not less than 5 step process with full refinement of each diamond pad up to 800 grit resin bonded pad with one application of densifier.
    - b. Gloss Reading: Not less than 55 according to ASTM E 430 before polish guard application.

### **3.5 PROTECTION**

- A. Apply sealer according to densifier manufacturer's written installation instructions.



- B. General: Institute protective procedures and install protective materials as required to ensure that Work of this Section will be without damage or deterioration at Substantial Completion.

**END OF SECTION**

## SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes resilient wall base, and moldings.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: Submit product data for each type of product indicated.
- B. CALgreen Submittals:
  - 1. Product Data for Section 5.504.4.1.1: For sealants, adhesives and caulks, provide documentation including printed statement of VOC content showing compliance with SCAQMD Rule 1168 VOC limits and CCR (California Code of Regulations) Title 17 for aerosols.
  - 2. Product Data for Section 5.504.4.1.2: Provide documentation for aerosol adhesives, and smaller unit sizes of adhesives, sealant, and caulking compounds (in units of product, less packaging, which do not weigh more than one (1) pound and do not consist of more than sixteen (16) fluid ounces) comply with statewide VOC standards and prohibitions on use of certain toxic compounds, of CCR Title 17, commencing with Section 94507.
  - 3. Product Data for Section 5.504.4.3: For architectural paints and coatings, provide documentation including printed statement of VOC content showing compliance with Table 1 of the ARB, Architectural Coatings Suggested Control Measure, unless more stringent local limits apply.
  - 4. Product Data for Section 5.504.4.3.1: Aerosol paints and coatings, provide documentation that products meet the PWMIR Limits for ROC in Section 94522 (a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Section 94522(c)(2 and (d)(2) of CCR Title 17.
  - 5. Compliance with Section 5.504.4.6: Provide documentation verifying that for eighty percent (80%) of the floor area receiving resilient flooring, the installed resilient flooring is:
    - a. Certified under the Resilient Floor Covering Institute (RFCI) FloorScore program;
    - b. Compliant with the VOC-emission limits and testing requirements specified in the California Department of Public Health's 2010 Standard Method for the Testing and Evaluation Chambers, Version 1.1, February 2010;
    - c. Compliant with the Collaborative for High Performance Schools California (CA-CHPS) Criteria Interpretation for EQ 7.0 and EQ 7.1 dated July 2012 and listed in the CHPS High Performance Product Database; or
    - d. Products certified under UL GREENGUARD.
- C. Samples: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

### 1.3 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. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

### 1.4 FIELD CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 RESILIENT WALL BASE (RB##)

- A. Products and Manufacturers: As indicated in Finish Schedule on Drawings. Nominal thickness not less than 1/8 inch unless greater thickness is scheduled. All resilient base shall be manufactured from rubber complying with ASTM F 1861, Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic), Group I (solid, homogeneous). Provide all resilient wall base in continuous coils to minimize field butt joints.
- B. Provide all resilient wall bases with a coved base toe style typically; and with straight flat or toeless base style at carpet, unless otherwise indicated in Finish Schedule on Drawings.

### 2.2 RESILIENT MOLDING ACCESSORY

- A. Description: Reducer strip for resilient floor covering.
- B. Material: Rubber.
- C. Profile and Dimensions: As indicated on the Drawings.

### **2.3 INSTALLATION MATERIALS**

- A. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
  - 1. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional regulations as shown in CALgreen Section 5.504.4.1.
  - 2. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds shall comply with regulations as shown in CALgreen Section 5.504.4.2.
  - 3. Paints and coatings shall comply with VOC content as shown in CALgreen Section 5.504.4.3.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.
  - 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.
  - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.

### **3.3 RESILIENT WALL BASE INSTALLATION**

- 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. Apply wall base with full adhesive coverage.
- E. Do not stretch wall base during installation.

- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
  - 1. Outside Corners: Use straight pieces of maximum lengths possible. 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: Use straight pieces of maximum lengths possible. 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.

### **3.4 RESILIENT ACCESSORY INSTALLATION**

- 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.

### **3.5 CLEANING AND PROTECTION**

- A. Remove adhesive and other blemishes from exposed surfaces.
- B. Perform the following operations immediately after completing resilient product installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
    - a. Do not wash surfaces until after time period recommended by manufacturer.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

### **END OF SECTION**

## **SECTION 09 68 13 - TILE CARPETING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes carpet tile.
- B. Related Requirements:
  - 1. Section 03 54 16 "Hydraulic Cement Underlayment" for patching and leveling of substrates
  - 2. Section 06 16 00 "Sheathing" for wood underlayment to receive tile carpeting.

#### **1.2 STANDARDS**

- A. Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:
  - 1. The Carpet and Rug Institute "The Carpet Specifiers' Handbook."
  - 2. The Carpet and Rug Institute "CRI 104; Standard for Installation of Commercial Carpet, edition Sept. 2015" (CRI 104).
  - 3. The Carpet and Rug Institute "Green Label Plus" Standards.

#### **1.3 PRE-INSTALLATION MEETINGS**

- A. Pre-Installation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
    - a. Review delivery, storage, and handling procedures.
    - b. Review ambient conditions and ventilation procedures.
    - c. Review subfloor preparation procedures.
- B. Prior to the installation, and at the Contractor's direction, meet at the project site to review the material selections, substrate preparations, installation procedures, coordination with other trades, special details and conditions, standard of workmanship, and other pertinent topics related to the Work. The meeting shall include the Owner, Architect, the Contractor, the installer, material manufacturer's representatives, and representatives of other trades or subcontractors affected by the installation.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each product indicated, submit product data, specifications, installation instructions for materials specified herein and other data as may be required to show compliance with the Contract Documents. Include installation recommendations for each type of substrate required.
- B. Sustainable Design Submittals:
1. CALgreen Submittals:
    - a. Product Data for Section 5.504.4.1.1: For sealants, adhesives and caulks, provide documentation including printed statement of VOC content showing compliance with SCAQMD Rule 1168 VOC limits and CCR (California Code of Regulations) Title 17 for aerosols.
    - b. Product Data for Section 5.504.4.1.2: Provide documentation for aerosol adhesives, and smaller unit sizes of adhesives, sealant, and caulking compounds (in units of product, less packaging, which do not weigh more than one (1) pound and do not consist of more than sixteen (16) fluid ounces) comply with statewide VOC standards and prohibitions on use of certain toxic compounds, of CCR Title 17, commencing with Section 94507.
    - c. Product Data for Section 5.504.4.4: Submit documentation that all carpet installed within the building interior complies with one of the following:
      - 1) Carpet and Rug Institute's Green Label Plus Program;
      - 2) The VOC-emission limits and testing requirements specified in the California Department of Public Health Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1, February 2010;
      - 3) NSF/ANSI 140 at the Gold level or higher;
      - 4) Scientific Certifications Systems Sustainable Choice;
      - 5) Compliant with the Collaborative for High Performance Schools California (CA-CHPS) Criteria Interpretation for EQ 7.0 and EQ 7.1 (formerly EQ 2.2) dated July 2012 and listed in the CHPS High Performance Product Database.
- C. Shop Drawings: Show the following:
1. Existing floor materials to be removed.
  2. Existing floor materials to remain.
  3. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
  4. Carpet tile type, color, and dye lot.
  5. Type of subfloor.
  6. Type of installation.
  7. Pattern of installation, direction, and starting points per floor.
  8. Pattern type and location.
  9. Type, color, and location of insets and borders.

10. Type, color, and location of edge, transition, and other accessory strips.
  11. Pile direction.
  12. Transition and other accessory strips.
  13. Transition details to other flooring materials.
- D. Samples: For each of the products showing full range of color, texture, and pattern variations expected. Prepare samples from same material to be used for the Work. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in Schedules. Submit the following:
1. Carpet Tile: Full-size Samples.
  2. Exposed Edge Stripping and Accessory: 12 inch long Samples.

### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Field Test Reports: Provide signed field test reports for tests indicated below. Indicate results and test locations. Include manufacturer's recommendations.
1. Anhydrous calcium chloride test results.
  2. Relative humidity probe test results.
  3. Alkalinity test results.
- C. Warranty: Submit special warranties specified in this Section.

### **1.6 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: Submit copies of instructions for care, cleaning, maintenance and repair of carpet tiles.
1. Each carpet manufacturer shall meet with the authorized Building Services personnel in the presence of the Owner, to review the characteristics of the carpet tile, and to recommend appropriate maintenance procedures, prior to occupancy of the finished spaces.
  2. Include methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
  3. Include precautions for cleaning materials and methods that could be detrimental to carpet tile.

### **1.7 MAINTENANCE MATERIAL SUBMITTALS**

- A. Extra Materials: 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. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

## **1.8 QUALITY ASSURANCE**

- A. Installer Qualifications: Engage a carpet installer, who has completed a minimum of three projects over the last 10 years which were similar in material, design and extent to that indicated for the Project - as determined by the Architect - and which have resulted in construction with a record of successful in service performance.
  1. In the case where the Installer is actually a Dealer, it is understood that the terms Installer, Dealer, Carpeting Contractor and Contractor shall be one and the same for purposes of this Contract. Installer shall assume responsibility for all of the work, including acquisition of the materials from the manufacturers herein specified.

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

- A. Comply with CRI 104.
- B. Deliver carpeting in original mill protective wrapping with mill register numbers and tags attached.
- C. Deliver other materials in manufacturer's unopened containers identified with name, brand, type, grade, class, and other qualifying information.
- D. Store materials in a dry location, in such a manner as to prevent damage.

## **1.10 FIELD CONDITIONS**

- A. General: Comply with CRI 104, Section 7.0 "Site Conditions."
- B. Environmental Limitations: Do not deliver or install carpet tile until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during remainder of construction.

## 1.11 WARRANTY

- A. Special Carpet Manufacturer's Warranty: Written warranty, signed by carpet tile manufacturer agreeing to replace carpet tile that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, wear, static buildup in excess of 3.0 kV when tested under the Standard Shuffle Test at 70 deg F and 20 percent RH, edge raveling without seam sealers, tuft bind loss, zippering (wet or dry), shrinkage, curling, doming, snags, runs, and delamination. Warrantees shall be full term, not pro-rated for the specified warranty period.
1. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Carpet Tile Installer's Warranty: Written warranty, signed by carpet tile installer agreeing to fix, repair or replace carpet tile that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than edge raveling, shrinkage, curling, doming, and delamination.
1. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 CARPET TILE (CP##)

- A. Carpet Tile Types: Provide manufacturer's commercial grade carpet tile for 100 percent glue-down installation as indicated in Finish Schedule on Drawings.

### 2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Portland cement-based formulation provided by or recommended by carpet tile manufacturer. Do not use gypsum based compounds.
- B. Adhesives: Water-resistant, mildew-resistant, and nonstaining, pressure sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for intended carpet tile, and recommended by manufacturer for releasable installation.
1. VOC Limits: Provide adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- C. Carpet Edging: Provide rubber composition carpet edging in single lengths wherever possible, keeping the number of joints or splices to a minimum. Provide in quantities and locations as job required based upon the recommended good practice of the industry; include in every location where carpet terminates and other flooring continues. Color to match adjacent carpet types.
  - 1. **Provide trim at full length of exposed carpet edges, maximum 1/4-inch height.**
- D. Floor Sealer: Type as recommended and manufactured by the carpet tile manufacturer for the applications indicated.
  - 1. VOC Limits: Provide floor sealer with VOC content not more than 200 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
  - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
  - 2. Subfloor finishes comply with requirements specified in Section 03 30 00 "Cast-in-Place Concrete" for slabs receiving carpet tile.
  - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. General: Comply with CRI 104, Section 8.0 "Substrate Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Coordinate the installation of carpet so as not to delay the occupancy of the site or interfere with the completion of construction.

- C. Examine the substrates, adjoining construction and the conditions under which the Work is to be installed. Verify recommended limits for moisture content and alkalinity of concrete substrates with carpet manufacturer.
1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    - b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
  2. Alkalinity Test: Verify alkalinity of concrete substrates by drilling a 3/8 inch diameter hole approximately 1/4 inch deep, remove all residue; fill with distilled water, allow water to stand 3 minutes and test with a calibrated electronic meter or pH paper. Perform testing at a frequency of not less than once every 1,000 square feet.
  3. Alternative test procedures for moisture content and alkalinity may be acceptable subject to the carpet manufacturer's review and written acceptance.
- D. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
1. Provide one of the following:
    - a. Remove coatings, including curing compounds, existing floor covering adhesive residues, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by the carpet manufacturer.
    - b. In lieu of mechanical substrate preparation methods, the Contractor may utilize floor sealer materials and methods of the types and methods as recommended, in writing, by the carpet tile manufacturer. Apply sealer in number of coats, and at the spread rate, as required by the carpet tile manufacturer.
  2. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by the carpet tile manufacturer.
  3. Use leveling and patching compounds recommended by flooring manufacturer for filling cracks, holes and depressions in the substrate. Surface shall be smooth, level and at proper elevation. Remove ridges, roughness and protrusions from concrete surfaces by grinding.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet.
- F. Carpet installation shall not commence until painting and finishing work are complete and ceiling and overhead work is tested, approved, and completed.

- G. Proceed with installation only after unsatisfactory conditions have been corrected

### 3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 10.0 "Carpet Tile Installation," carpet tile manufacturer's written installation instructions, and as required to match the accepted sample installations. Apply adhesive in accordance with adhesive manufacturer's directions.
- B. Adhere all full size, perimeter tiles, and cut tiles, with a full spread of adhesive. Dry fit cut tiles and apply adhesive to tile back after tile has been cut. Use full uncut tiles down the center of corridors and, where necessary, cut perimeter tiles to butt walls.
1. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
  2. Cut openings in carpet for electrical outlets, piping and other penetrations. Maintain close tolerances so that edges of carpet will be covered by plates and escutcheons.
  3. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- C. Butt carpet tile tightly together to form seams without gaps or entrapped pile yarns and aligned with adjoining tiles.
- D. Edge Strip Installation: **Exposed edges of carpet shall be fully adhered to floor slab.** Install edge strip at every location where edge of carpet is exposed to traffic, unless otherwise indicated. Unless otherwise directed by Architect install in single lengths and secure in accordance with manufacturer's directions.
- E. Traffic over adhesive installations shall be restricted until adhesive has properly cured in accordance with the adhesive manufacturer's recommendations.

### 3.4 CLEANING AND PROTECTION

- A. Cleaning: As the carpeting is installed, remove and dispose of all trimmings, excess pieces of carpeting and laying materials from each area as it is completed. Vacuum carpeting with a commercial vacuum, having a cylindrical brush or beater bar and high suction. Remove adhesives, stains, and soil spots in accordance with the carpet manufacturer's recommendations.
- B. Protection: Protect installed carpet tile to comply with CRI 104, Section 11.0 "Post Installation," and against damage as damaged carpeting shall be rejected. Use non-staining cover material for protection. Tape joints of protective covering.
1. Plastic and polyethylene sheet protective coverings shall not be permitted.
  2. Remove and replace rejected carpeting with new carpet tile. At the completion of the Work and when directed by the Architect, remove covering, vacuum clean carpeting and remove soiling and stains (if any) to the satisfaction of the Architect.

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**END OF SECTION**

## SECTION 09 72 00 - WALL COVERINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes tackable wall coverings and accessories necessary for a complete installation.
- B. Related Requirements:
  - 1. Section 09 29 00 "Gypsum Board" for Levels 4 and 5 finishes required under wallcovering.
  - 2. Section 09 91 23 "Interior Painting" for priming wall surfaces.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: Submit product data for each type of product.
  - 1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.
- B. CALgreen Submittals:
  - 1. Product Data for Section 5.504.4.1.1: For sealants, adhesives and caulks, provide documentation including printed statement of VOC content showing compliance with SCAQMD Rule 1168 VOC limits and CCR (California Code of Regulations) Title 17 for aerosols.
  - 2. Product Data for Section 5.504.4.1.2: Provide documentation for aerosol adhesives, and smaller unit sizes of adhesives, sealant, and caulking compounds (in units of product, less packaging, which do not weigh more than one (1) pound and do not consist of more than sixteen (16) fluid ounces) comply with statewide VOC standards and prohibitions on use of certain toxic compounds, of CCR Title 17, commencing with Section 94507.
  - 3. Product Data for Section 5.504.4.3: For architectural paints and coatings, provide documentation including printed statement of VOC content showing compliance with Table 1 of the ARB, Architectural Coatings Suggested Control Measure, unless more stringent local limits apply.
  - 4. Product Data for Section 5.504.4.3.1: Aerosol paints and coatings, provide documentation that products meet the PWMIR Limits for ROC in Section 94522 (a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Section 94522(c)(2) and (d)(2) of CCR Title 17.
- C. Shop Drawings: Include location and extent of each wall covering type, seam locations and termination points.

- D. Samples: Submit wall covering samples in full width by 36-inch- long sections of wall covering for each wall covering indicated and for each color, pattern, and texture required. Samples shall show complete pattern repeat.
  - 1. Wall-Covering Sample: Submit samples from same production run to be used for the Work, with specified treatments applied. Mark top and face of fabric.
- E. Maintenance Data: Submit maintenance data for wall coverings.

### **1.3 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For wall coverings to include in maintenance manuals.

### **1.4 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials described below, before installation begins, from the same production run as the wall coverings installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Rolls of Wall Covering Material: Full-width rolls of wall covering equal to 5 percent of amount of each type installed, but not less than 1 full roll.

### **1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Engage an experienced installer who has specialized in the installation of wall coverings similar to that required for this project.

### **1.6 FIELD CONDITIONS**

- A. Environmental Limitations: Do not deliver or install wall coverings until wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at the levels indicated when the site is occupied for its intended use.
- B. Lighting: Do not install wall covering until a permanent level of lighting is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.



## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace wall covering that does not comply with requirements or that fails within two years from date of Substantial Completion. Warranty does not include deterioration or failure of wall covering from failure of substrate, vandalism, or abuse. Failures include, but are not limited to, blistering, fading, fraying, seam delamination, and discoloration.

## PART 2 - PRODUCTS

### 2.1 WALL COVERING PRODUCTS (WC##)

- A. General: Provide rolls of each type of wall covering from the same run number or dye lot. Color and pattern matching Architect's samples.
  - 1. Paints and coatings shall comply with VOC content as shown in CALgreen Section 5.504.4.3.
- B. Product(s): As indicated in Finish Schedule on Drawings.
  - 1. Tackable Wall Coverings: Manufacturer's standard linoleum/cork blend product, installed where indicated on Drawings. Basis of Design Product: Koroseal Tac Wall.

### 2.2 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.
  - 1. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional regulations as shown in CALgreen Section 5.504.4.1.
  - 2. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds shall comply with regulations as shown in CALgreen Section 5.504.4.2.
- B. Primer/Sealer: Mildew resistant, primer/sealer recommended in writing by the wall-covering manufacturer for intended substrate.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair bond of wall covering, including including mold, mildew, oil, grease, incompatible primers, dirt, and dust.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
  - 1. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
- D. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- E. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

#### **3.3 WALL-COVERING INSTALLATION**

- A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.
- B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.
- C. Install strips in same order as cut from roll.
  - 1. For solid-color, even-texture, or random-match wall coverings, reverse every other strip.
- D. Install wall covering without lifted or curling edges and without visible shrinkage.
- E. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.

- F. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

### **3.4 CLEANING**

- A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended in writing by wall-covering manufacturer.
- C. Replace strips that cannot be cleaned.
- D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

**END OF SECTION**

## **SECTION 09 77 23 - FABRIC-WRAPPED PANELS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes fabric-wrapped wall panels.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of panel edge and core material specified.
- B. Shop Drawings: Include attachment devices; and details at head, base, joints, corners, and intersections with shelves, countertops, doors, electrical outlets and switches, thermostats, and other components. Indicate panel edge and core materials.
  - 1. Include elevations showing panel sizes and direction of fabric weave.
- C. Samples: For each type fabric-wrapped panel and in each color and texture required. Prepare samples from same material to be used for the Work. Include full size sample of attachment device.

#### **1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Warranty: Special warranty specified in this Section.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For fabric-wrapped panels. Include fabric manufacturer's cleaning and stain-removal recommendations.

#### **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. Fabric: For each fabric, color, and pattern installed, provide length equal to 10 percent of amount installed, but not less than 3 yd..

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Fire-Test-Response Characteristics: Provide fabric-wrapped panels with flame spread and smoke developed indices of 25 or less and 450 or less, respectively, as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials, fabrication, and installation.
  - 1. Install mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
  - 2. Install mockup of typical wall area as shown on Drawings.
    - a. Include intersection at wall and ceiling, and door opening.
  - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect fabric-wrapped panels from excessive moisture in shipment, storage, and handling. Deliver in unopened bundles and store in a dry place with adequate air circulation.

## 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install fabric-wrapped panels 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. Lighting: Do not install fabric-wrapped panels until a permanent level of lighting is provided on surfaces to receive fabric-wrapped panels.
- C. Air-Quality Limitations: Protect fabric-wrapped panels from exposure to airborne odors such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify locations of fabric-wrapped panels by field measurements before fabrication and indicate measurements on Shop Drawings.

## 1.9 WARRANTY

- A. Special Warranty: Written warranty, signed by fabric-wrapped panel manufacturer agreeing to repair or replace panels that fail in materials or workmanship within two years from date of Substantial Completion. Failures include, but are not limited to, fabric sagging, distorting, or releasing from panel edge.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Benton Brothers Solutions.
  - 2. Interior Acoustics, Inc.
  - 3. Panel Solutions.
  - 4. StretchWall Products, Inc.

### 2.2 FABRIC-WRAPPED PANELS (FW##)

- A. Wall materials shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Provide fabric-wrapped panels as follows:
  - 1. Edge Profile: Square.
  - 2. Panel Edge: Extruded PVC.
  - 3. Nominal Panel-Edge Thickness: As scheduled.

### 2.3 CORE MATERIALS

- A. General: Provide tackable core materials with installed NRC of 1.00 or greater.
- B. Mineral-Fiber Board: Density of 23 lbs./cu. ft., plus or minus 3 lbs./cu. ft..
  - 1. Surface: Perforated.
  - 2. Maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.
  - 3. Available Product: Subject to compliance with requirements provide "Micore 300" by United States Gypsum Company.
- C. Polyester Board: LBI/Boyd; EcoCore.

## 2.4 FABRIC

- A. Face Fabric: Subject to compliance with requirements, provide fabrics indicated for each designation in Finish Schedule on Drawings.
- B. Lining Material: If recommended by fabricator or by Architect in review of mockup, provide lining fabric. Lining fabric shall be product recommended by manufacturer of face fabric for application intended.

## 2.5 FABRICATION

- A. Fabric-Wrapped Panels: Fabric straight and on the grain. No seams are allowed.
- B. Fabricate panels with patterned or directional weave fabrics so pattern or weave matches in adjacent panels.
- C. Stretch fabric tight and square without puckers, ripples, sagging, or distortions. Do not adhere fabric to panel face.
- D. Mounting Devices: Metal "Z"-clips, concealed on back of panel, recommended to support weight of panel, with base-support bracket system where recommended by manufacturer for additional support of panels.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Examine fabric, substrates, and conditions, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of fabric-wrapped panels.
- B. Install fabric-wrapped panels vertical and plumb, if applicable; true in plane; and with fabric installed square to the grain. Match and level fabric pattern and grain.
- C. Panel Joints: No greater than 1/32 inch wide.

## END OF SECTION

## **SECTION 09 81 33 – ACOUSTICAL INSULATION, SEALANTS AND ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED WORK**

- A. Requirements: Provide acoustical insulation, sealants and moldable putty pads in accordance with Contract Documents
- B. Related Sections.
  - 1. Section 09 29 00 – Gypsum Board Assemblies.
  - 2. Section 09 22 16 – Non-Structural Metal Framing

#### **1.2 SUBMITTALS**

- A. General: Submit the following in accordance with Section 01 30 00 – Submittals.
- B. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance with the Contract Documents, excluding material safety data sheets (MSDSs) for products listed below.
- C. Manufacturer's Instructions: Submit manufacturer's instructions for proper installation of products listed below.
- D. Warranty Documentation: Submit warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.

#### **1.3 QUALITY ASSURANCE**

- A. Source Limitations: Insulation and accessories must be obtained through one source from the same manufacturer (to ensure compatibility, regulator conformance and a warrantable installation).

#### **1.4 DELIVERY AND STORAGE**

- A. Delivery: Deliver in manufacturer's unopened containers fully identified with manufacturer's name, trade name, type, class, grade, and size.
- B. Storage: Store in unopened containers, off ground and protected from damage.



## **PART 2 - PRODUCTS**

- A. Unfaced Mineral/Glass Fiber Blanket/Batt Acoustical Insulation: Three-inch thick (minimum) unfaced semi-rigid mineral fiber or glass fiber blankets. Acoustical insulation to comply with ASTM C665, Type I, with maximum flame spread of 25 and smoke development of 50 per ASTM E 84.
  - 1. Johns Manville Unfaced Fiber Glass Insulation
  - 2. Owens Corning Sound Attenuation Batt Insulation
  - 3. Certainteed NoiseReducer Insulation
  - 4. or approved equal.
  
- B. Sound Attenuating Fire Blanket Insulation: Asbestos-free mineral fiber insulation manufactured from slab and natural occurring rock and conforming to ASTM C665 requirements for Type 1 insulation.
  - 1. Owens Corning Thermafiber SAFB
  - 2. Roxul Safe 45
  - 3. Fibrex FBX Industrial Board Insulations
  - 4. Or approved equal.
  
- C. Acoustical Sealant: Non-drying, non-hardening, non-skinning, non-staining, gunnable, synthetic rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound.
  - 1. USG Sheetrock Brand Acoustical Sealant
  - 2. Tremco Acoustical Sealant
  - 3. Pecora Corp AIS-919 Acoustical Sealant
  - 4. or approved equal.
  
- D. Moldable Sheet Caulk or Firestop Putty Pads for Electrical Outlet Boxes: Putty pads should consist of a non-hardening, intumescent compound 1/8-inch thick minimum sheet caulk designed to seal the back and sides of electrical outlet boxes.
  - 1. Harry A Lowry Outlet Box Pads.
  - 2. 3M Fire Barrier Moldable Putty Pads MPP+.
  - 3. Kinetics Noise Control IsoBacker Putty pads
  - 4. or approved equal.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

- A. Examination: Examine substrates, adjoining construction and condition under which Work is to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected

**3.2 OUTLET BOX AND AV BACK BOX PADS (WALL AND SOUND CONTROL CEILINGS)**

- A. Ensure that the surface of the electrical outlet and AV Back boxes are clean of dirt, rust, oil, release agents, repellants and any other substances that may affect proper adhesion.
- B. All wiring shall be completed prior to the installation of the moldable putty pads.
- C. Wrap the back and sides of the electrical outlet and AV Back boxes located within acoustic walls and ceilings with 1/8-inch moldable putty pads. The pads shall provide an airtight seal around the perimeter of the boxes.
- D. Caulk the joint between the electrical outlet and AV Back boxes and adjacent gypsum board with acoustical sealant.

**END OF SECTION 09 81 33**

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## **SECTION 09 84 13 – FIXED SOUND ABSORPTIVE PANEL**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. The work consists of furnishing all labor, materials, accessories and equipment necessary to provide sound absorptive panels as indicated on project Drawings and as specified below. Sound absorptive panel materials shall be designed to achieve the minimum sound absorption coefficients and minimum NRC ratings specified below.

#### **1.2 RELATED DOCUMENTS**

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

#### **1.3 REFERENCES**

- A. ASTM C423 – Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- B. ASTM E 795, Standard Practice for Mounting Test Specimens during Sound Absorption Tests.
- C. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

#### **1.4 SUBMITTALS**

- A. Compliance: Comply with pertinent provisions of Division 1 – General Requirements.
- B. Product Data: For each type of panel edge, core material and mounting indicated, submit Manufacturer's specifications and other data needed to prove compliance with all specified requirements.
- C. Acoustical Test Reports: Submit manufacturer's sound absorption data for specified systems, including; octave band sound absorption values from 125 hertz to 4,000 hertz and Noise Reduction Coefficient (NRC) values for the specified systems. Sound absorption data shall be based on measurements conducted by a laboratory accredited for specific acoustical testing under the National Voluntary Laboratory Accreditation Program (NVLAP) and in accordance with ASTM C 423 and ASTM E795 standards.
- D. Shop Drawings: For sound absorptive panels, include mounting devices and details; details at panel head, base, joints and corners; and details at ceiling, floor base and wall intersections. Indicate panel edge and core materials. All materials affected by structural or seismic requirements shall be reviewed and signed by a registered structural engineer showing compliance with all structural load and seismic design criteria.

1. Include elevations showing panel sizes and direction of fabric weave and pattern matching.
- E. Coordination Drawings: Show intersections with wall base, doors, electrical outlets and switches, and other permanent wall features.
- F. Exceptions: Identify all proposed changes, differences, and/or discrepancies, including verbiage, terms, definitions between Contract Documents and submittals.
- G. Maintenance Data: For stretched fabric wall systems to include in maintenance manuals. Include fabric manufacturer's written cleaning and stain removal recommendations.
- H. Warranty: Warranty specified in this Section.

## 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: The Manufacturer shall have successful experience in acoustical surface finish fabrication and installation, including no less than five years experience in the fabrication and installation of materials identical to those required in this project
- B. Source Limitations: Obtain sound absorptive panels through one source from a single manufacturer.
- C. Acoustical Performance: Sound absorption tests shall be conducted in accordance with ASTM C 423 – Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method and ASTM E 795 – Standard Practices for Mounting Specimens during Sound Absorption Tests. The test shall be conducted by a laboratory accredited for specific acoustical testing under the National Voluntary Laboratory Accreditation Program (NVLAP). Acoustical test reports shall include a description of the tested material sample, size of the sample, test setup (including type of mounting used), measurement instrumentation, test procedure and octave band sound absorption coefficients.
- D. Fire-Test Response Characteristics: Provide sound absorptive panels with the following surface burning characteristics as determined by testing identical products per ASTM 84 by UL or other testing and inspecting agency acceptable to authorities having jurisdiction:
  1. Flame-Spread Index: 25 or less.
  2. Smoke Development Index: 450 or less.
- E. Mockups: Before installing sound absorptive panels, install mockups for each form from panel and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Install mockups to comply with the following requirements, using materials indicated for the completed Work:
  1. Install mockups in the location and of the size indicated or, if not indicated, as directed by the Architect.
  2. Notify Architect seven days in advance of dates and times when mockups will be installed.

3. Obtain Architect's approval of mockups before starting installation of sound absorptive panels.
4. Maintain mockups during installation in an undisturbed condition as a standard for judging the completed Work.
  - a. Demolish and remove mockups when directed.
  - b. Approved mockups may become part of the completed Work if undisturbed at the time of Substantial Completion.

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

- A. Comply with sound absorptive panel manufacturer's written instructions for minimum and maximum temperature and humidity requirements for shipment, storage and handling.
- B. Protect products during transit, storage and handling to prevent damage, soiling and deterioration. Comply with the requirements of the manufacturer's instructions for storage and handling.
  1. Package products at factory prior to shipping using manufacturer's standard method.
- C. Deliver materials and panels in unopened bundles and store in a temperature controlled dry place with adequate air circulation.
- D. Protect panel edges from crushing and impact.

## **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.
- B. Mounting Devices: Full size units equal to 5 percent of amount installed, but no fewer than five devices, including unopened adhesives.
- C. Protect products during transit, storage and handling to prevent damage, soiling and deterioration. Comply with the requirements of the manufacturer's instructions for storage and handling.

## **1.8 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not install sound absorptive panels 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: Verify locations of sound absorptive panels by field measurements before fabrication and indicate measurements on Shop Drawings.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sound absorptive panels that fail in materials or workmanship within specified warranty period.
- B. Failures include, but are not limited to, fabric sagging, distorting or releasing from panel edge; or warping of core.
- C. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. IMPACT RESISTANT FABRIC WRAPPED ACOUSTICAL PANEL (TYPES AP-01, AP-02, AP-03)
  - 1. Application: Walls or Ceilings, as indicated or scheduled on the drawings.
  - 2. Configuration: Dual core construction of dimensionally stable medium density fiberglass insulation with a thin high density impact resistant face sheet adhered to medium density core. Insulation core and face sheet shall be covered with approved acoustically transparent fabric.
  - 3. Thickness: 1-1/8 inches.
  - 4. Insulation: Unfaced fiberglass core, 6-7 pounds per cubic foot density, dimensionally stable, molded rigid board with 16-20 pcf density impact resistant acoustically transparent face sheet.
  - 5. Edge Detail: As specified by Architect.
  - 6. Fabric: Acoustically transparent. Fabric shall be selected by architect, but shall not have backing or any other material with sound blocking properties. A misting of glue shall be used on the front face of the panel to adhere the fabric to the fiberglass insulation core. The gluing process shall not compromise the assembly's sound absorption properties. When fabric is peeled away from the fiberglass insulation core, the fabric shall not retain any fiberglass insulation material as a result of the gluing process. The finish shall be flat and wrinkle free and fully tailored at corners with no exposed darting.
  - 7. Minimum Sound Absorption Coefficients:
    - a. NRC 1.00 at 1-1/8 inch thickness (Type A-mounting)
  - 8. Mounting: Mechanical fastening per manufacturers instructions.
  - 9. Products: Kinetics Hardside High Impact or approved equal.
- B. IMPACT RESISTANT FABRIC WRAPPED ACOUSTICAL PANEL (TYPE AP-03)
  - 1. Application: Walls or Ceilings, as indicated or scheduled on the drawings.
  - 2. Configuration: Dual core construction of dimensionally stable medium density fiberglass insulation with a thin high density impact resistant face sheet adhered to medium density

- core. Insulation core and face sheet shall be covered with approved acoustically transparent fabric.
3. Thickness: 1-1/8 inches.
  4. Insulation: Unfaced fiberglass core, 6-7 pounds per cubic foot density, dimensionally stable, molded rigid board with 16-20 pcf density impact resistant acoustically transparent face sheet.
  5. Edge Detail: As specified by Architect.
  6. Fabric: Acoustically transparent. Fabric shall be selected by architect, but shall not have backing or any other material with sound blocking properties. A misting of glue shall be used on the front face of the panel to adhere the fabric to the fiberglass insulation core. The gluing process shall not compromise the assembly's sound absorption properties. When fabric is peeled away from the fiberglass insulation core, the fabric shall not retain any fiberglass insulation material as a result of the gluing process. The finish shall be flat and wrinkle free and fully tailored at corners with no exposed darting.
  7. Minimum Sound Absorption Coefficients:
    - a. NRC 1.05 at 2-1/8 inch thickness (Type A-mounting)
  8. Mounting: Mechanical fastening per manufacturers instructions.
  9. Products: Kinetics Hardside High Impact or approved equal.

### PART 3 - EXECUTION

#### ADDENDUM 3 RFI 31

31. Q: In section 098413 page 5, paragraph B.3, it lists thickness as 1 1/8" but B.7.a. lists thickness as 2 1/8". Which is correct?

A: Thickness is per detail described in drawings, which is in accordance with related specification section

#### 3.1 EXAMINATION

- A. Examine fabric, materials, substrates, areas and conditions, with the installer present, for compliance with requirements, installation tolerances and other conditions affecting performance of the acoustical surface finishes.
- B. Do not proceed with Work until unsatisfactory conditions have been corrected.
- C. Clean acoustical surface finishes and hardware to remove deleterious and soil substances. Description

#### 3.2 PREPARATION

- A. Measure each area and establish layout of panels and joints as indicated in the Drawings.
- B. Before installation, allow acoustical surface finishes to adjust and become stable in the area in which they will be installed in accordance with the manufacturers installation instructions.

#### 3.3 INSTALLATION

- A. Do not install any work until space is enclosed and weatherproofed, wet work in space is completed and nominally dry, work above ceilings is complete and temperature and humidity is continuously maintained at values near those of final occupancy.



- B. Comply with the manufacturers printed instructions, recommendations and approved shop drawings.
- C. Install framework, support hardware, acoustical surface finishes in accordance with the manufacturers instructions and recommendations. Install panels vertical and plumb and if applicable, true in plane.

### **3.4 INSTALLATION TOLERANCES**

- A. Edge Straightness: Plus or minus 1/16-inch over 8-feet.
- B. Variation from Level and Plumb: Plus or minus 1/16-inch over 8-feet.
- C. Variation of Panel-Joint Width: Not more than hairline.

### **3.5 CLEANING**

- A. Clean all surfaces following installation.
- B. Replace material having scratches, abrasions or other defects with unblemished acoustical surface finish assemblies at no cost to the owner.

### **3.6 PROTECTION**

- A. Protection of acoustical surface finishes from damage by other trades after installation shall be provided by the General Contractor.

**END OF SECTION 09 84 13**

## **SECTION 09 91 13 - EXTERIOR PAINTING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes surface preparation and the application of paint systems on exterior substrates as scheduled.
- B. Related Requirements:
  - 1. Section 09 91 23 "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

#### **1.2 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 1 gal. of each material and color applied.

#### **1.3 QUALITY ASSURANCE**

- A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 20 sq. ft..
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide exterior paint systems by PPG Paints (PPG), as scheduled in Part 3 of this Section, or comparable products by one of the following:
  - 1. Dunn-Edwards Paints (D-E)
  - 2. Sherwin-Williams Company (The). (SW)
  - 3. Vista Paint Corp. (Vista).
- B. Products: Subject to compliance with requirements, provide one of the products listed in Part 3 articles for the paint category indicated.
  - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers.

### **2.2 PAINT, GENERAL**

- A. Material Compatibility: 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. 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.
- B. VOC Content: Products shall comply with the more stringent requirements of EPA 63 FR 176: 48848 and the following:
  - 1. South Coast Air Quality Management District (SCAQMD), Rule 1113, latest adopted requirements.
- C. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
- D. Colors and Gloss: As indicated in Finish Schedule on Drawings. Reference to a particular manufacturer's number or color name is used only as a convenience for the Architect in order to establish the Project color and gloss requirements. These references are not intended to describe the required specific paint systems. For specific paint system requirements, refer to the "Exterior Paint Schedule" at the end of Part 3, as applicable to the respective conditions of use.

1. The selection of paint colors and gloss are indicated by manufacturer and color type; designated as "PT##."

### **PART 3 - EXECUTION**

#### **3.1 EXTERIOR PAINTING SCHEDULE**

- A. Ferrous Metal Substrates: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
  1. Acrylic-Enamel Finish: Two finish coats over a rust-inhibitive primer (primer required for items not shop-primed).
    - a. Primer for Items Not Shop-Primed: PPG; 90-712 Pitt-Tech Interior/Exterior Primer Finish DTM Industrial Enamel. Dry Film Thickness: Not less than 3.0 mils.
    - b. Intermediate Coat: PPG; 90-1210 Series Pitt-Tech Plus Interior/Exterior Semi-gloss DTM Industrial Enamel. Dry Film Thickness: Not Less than 2.0 mils.
    - c. Top Coat: PPG; 90-1210 Series Pitt-Tech Plus Interior/Exterior Semi-gloss DTM Industrial Enamel. Dry Film Thickness: Not Less than 2.0 mils.
- B. Galvanized Metal Substrates: Provide the following finish systems over exterior zinc-coated metal surfaces.
  1. Acrylic-Enamel Finish: Two finish coats over galvanized metal primer.
    - a. Primer: PPG; 90-712 Pitt Tech Interior/Exterior Primer/Finish DTM Industrial Enamel. Dry Film Thickness: Not less than 3.0 mils.
    - b. Intermediate Coat: PPG; 90-1210 Series Pitt-Tech Plus Interior/Exterior Semi-gloss DTM Industrial Enamel. Dry Film Thickness: Not less than 2.0 mils.
    - c. Top Coat: PPG; 90-1210 Series Pitt-Tech Plus Interior/Exterior Semi-gloss DTM Industrial Enamel. Dry Film Thickness: Not less than 2.0 mils.

### **END OF SECTION**

## **SECTION 09 91 23 - INTERIOR PAINTING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes surface preparation and field application of paint systems on the following interior substrates:
  - 1. Gypsum board.
  - 2. Steel.

#### **1.2 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 1 gal. of each material and color applied.

#### **1.3 QUALITY ASSURANCE**

- A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Sample Installation: Apply sample installation of each paint system indicated and each color and finish selected to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
    - b. Other Items: Architect will designate items or areas required.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in sample installations unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved sample installations may become part of the completed Work if undisturbed at time of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with requirements, provide interior paint systems by PPG Paints (PPG), as scheduled in Part 3 of this Section, or comparable products by one of the following:
  - 1. Dunn-Edwards Paints (D-E)
  - 2. Sherwin-Williams Co. (SW)
  - 3. Vista Paint Corporation (Vista)
- B. Products: Subject to compliance with requirements, provide the products listed in other Part 3 articles for the paint category indicated.
  - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers.

### **2.2 PAINT, GENERAL (PT\_\_)**

- A. Material Compatibility: Provide materials for use within each paint system that are compatible with one another and with the substrates indicated, under conditions of service and application, as demonstrated by manufacturer based on testing and field experience. 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.
- B. VOC Content: Products shall comply with the more stringent requirements of EPA 63 FR 176: 48848 and the following:
  - 1. South Coast Air Quality Management District (SCAQMD), Rule 1113, latest adopted requirements.
- C. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
- D. Colors and Gloss: As indicated in Finish Schedule on Drawings. Reference to a particular manufacturer's number or color name is used only as a convenience for the Architect in order to establish the Project color and gloss requirements. These references are not intended to describe the required specific paint systems. For specific paint system requirements, refer to the "Interior Paint Schedule" at the end of Part 3, as applicable to the respective conditions of use.
  - 1. The selection of paint colors and gloss are indicated by manufacturer and color type; designated as "PT##."

2. Furnish the same lots, batches, etc. within the same contiguous areas of the building (i.e., corridors on the same floors, common rooms which adjoin each other, etc.).

### **PART 3 - EXECUTION**

#### **3.1 MARKING AND IDENTIFICATION**

- A. Mark fire-rated and smoke-rated partitions required to have protective openings or penetrations.
  1. Locate markings in accessible concealed floor, floor-ceiling, or attic spaces.
  2. Provide markings within 15 feet of the end of each wall and at intervals not exceeding 30 feet measured horizontally along the partition.
  3. Marking shall include stenciled lettering not less than 3 inches in height with a minimum 3/8 inch stroke.
  4. Apply markings in a contrasting color with the suggested wording "FIRE AND/OR SMOKE BARRIER---PROTECT ALL OPENINGS", or other wording as approved by the Authority Having Jurisdiction.
- B. Mark sound-rated partitions as follows:
  1. Locate markings in accessible concealed floor, floor-ceiling, or attic spaces.
  2. Provide markings within 15 feet of the end of each wall and at intervals not exceeding 30 feet measured horizontally along the partition.
  3. Marking shall include stenciled lettering not less than 3 inches in height with a minimum 3/8 inch stroke.
  4. Apply markings in a contrasting color with the suggested wording "STC 45 PARTITION---PROTECT ALL OPENINGS", or other wording as approved by the Owner.

#### **3.2 INTERIOR PAINTING SCHEDULE**

- A. Gypsum Board Substrates:
  1. High-Performance Architectural Latex System:
    - a. Primer: PPG Paints; 6-2 SpeedHide Interior Quick-Drying Latex Sealer. Dry Film Thickness: Not less than 1.0 mil.
    - b. Intermediate Coat: PPG Paints; 6-3511 Series Speedhide Interior Satin Latex. Dry Film Thickness: Not less than 1.3 mils.
    - c. Topcoat: PPG Paints; 6-3511 Series Speedhide Interior Satin Latex. Dry Film Thickness: Not less than 1.3 mils. (Note: Provide flat finish at gypsum board ceilings).
- B. Steel Substrates:
  1. High-Performance Architectural Latex System:

- a. Primer: PPG; 90-712 Pitt-Tech Interior/Exterior Primer/Finish DTM Industrial Enamel. Dry Film Thickness: Not less than 2.0 mils.
- b. Intermediate Coat: PPG Paints; 6-500 Series SpeedHide Interior Semi-Gloss Latex. Dry Film Thickness: Not less than 1.4 mils.
- c. Topcoat: PPG Paints; 6-500 Series SpeedHide Interior Semi-Gloss Latex. Dry Film Thickness: Not less than 1.4 mils.

C. Steel (Factory-Primed) Substrates:

1. High-Performance Architectural Latex System:

- a. Primer: PPG; 90-712 Pitt-Tech Interior/Exterior Primer/Finish DTM Industrial Enamel. Dry Film Thickness: Not less than 2.0 mils. (applied over factory primer).
- b. Intermediate Coat: PPG Paints; 6-500 Series SpeedHide Interior Semi-Gloss Latex. Dry Film Thickness: Not less than 1.4 mils.
- c. Topcoat: PPG Paints; 6-500 Series SpeedHide Interior Semi-Gloss Latex. Dry Film Thickness: Not less than 1.4 mils.

**END OF SECTION**



## SECTION 09 96 00.13 - EXTERIOR HIGH PERFORMANCE COATINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes surface preparation and the application of high-performance coating systems on exterior substrates. The substrates include:
1. Substrates:
    - a. Architecturally exposed structural steel.
    - b. Galvanized steel.
- B. Related Requirements:
1. Factory- or shop-applied primers applied as Work of other Sections must be coordinated with field-applied finish coats. Review other Sections for factory- or shop-primed products and reference this Section for product requirements:
  2. Section 05 50 00 "Metal Fabrications" for shop priming of metal substrates with primers specified in this Section.
  3. Section 09 91 13 "Exterior Painting" for general field painting.
  4. Section 09 91 23 "Interior Painting" for general field painting.

#### 1.2 DEFINITIONS

- A. Definitions of gloss levels below are from "MPI Architectural Painting Specification Manual" (hereafter, "MPI Manual").
1. Gloss Level 1, Matte or Flat finish: 0 to 5 units at 60 degrees and maximum 10 units at 85 degrees.
  2. Gloss Level 2, Velvet finish: Maximum 10 units at 60 degrees and 10 to 35 units at 85 degrees.
  3. Gloss Level 3, Eggshell finish: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees.
  4. Gloss Level 4, Satin finish: 20 to 35 units at 60 degrees and minimum 35 units at 85 degrees.
  5. Gloss Level 5, Semi-Gloss finish: 35 to 70 units at 60 degrees.
  6. Gloss Level 6, Gloss finish: 70 to 85 units at 60 degrees.
  7. Gloss Level 7, High-Gloss finish: More than 85 units at 60 degrees.
- B. Blocking: Two painted surfaces sticking together such as a painted door sticking to a painted jamb.
- C. ASTM: ASTM International develops international standards for materials, products, systems and services used in construction, manufacturing and transportation: [www.astm.org](http://www.astm.org).

- D. Bio-Pruf™: Anti-microbial additive that inhibits the growth of odor and stain causing mold and mildew on the paint film. "Antimicrobial" is defined as any means or mode of restricting growth or spread of microbes.
- E. CHPS: Collaborative for High Performance Schools. A national movement to improve student performance and the entire educational experience by building the best possible schools: [www.chps.net](http://www.chps.net).
- F. CRGI: Coatings Research Group Inc. is an international association of paint and coatings manufacturers dedicated to the benefits of shared research and development: [crgiconnect.com](http://crgiconnect.com).
- G. DTM: Direct to metal. A coating that can be applied directly to a metal surface; refer to manufacturer's product information for surface preparation and application instructions.
- H. EG: Ethylene Glycol. Ethylene glycol is listed as a hazardous air pollutant (HAP) by the U.S. EPA: [www.epa.gov](http://www.epa.gov).
- I. EPR: Environmental Performance Rating. Master Painters Institute's formula that relates VOC, Performance of Category, Gloss and Appropriate specified use. Higher values equate to greater eco- efficiency.
- J. HAP: Hazardous Air Pollutant: According to the United States Environmental Protection Agency (EPA), Hazardous air pollutants, also known as toxic air pollutants or air toxics, are those pollutants that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects: [www.epa.gov](http://www.epa.gov).
- K. LEED: LEED (Leadership in Energy and Environmental Design) is a voluntary, consensus-based, market- driven program that provides third-party verification of green buildings: [www.usgbc.org](http://www.usgbc.org).
- L. MPI: Master Painters Institute. An organization that establishes architectural paint standards and quality assurance programs in North America: [www.paintinfo.com](http://www.paintinfo.com).
- M. NACE: National Association of Corrosion Engineers [www.nace.org](http://www.nace.org).
- N. PDCA: Painting & Decorating Contractors of America: [www.pdca.org](http://www.pdca.org).
- O. RAVOC: Reactivity adjusted VOC. 'Reactivity' means the ability of a VOC to promote ozone formation.
- P. SCAQMD: South Coast Air Quality Management District is defined as most of Los Angeles, Orange, Riverside, and San Bernardino counties in California.
- Q. CARB: California Air Resources Board District is defined as the counties outside of SCAQMD.
- R. OTC: Refers to the Ozone Transmission Commission.

- S. SSPC: The Society for Protective Coatings. Surface preparation standards and specifications. [www.sspc.org](http://www.sspc.org).
- T. ICRI: International Concrete Repair Institute. [www.icri.org](http://www.icri.org).

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data for each type of coating system, label analysis and instructions for handling, storing, and applying each material specified. Include preparation requirements and application instructions.
  - 1. Product List: Cross reference to coating system and locations of application areas. Use same designations indicated on Drawings and in Finish Schedules. Include manufacturer's recommended spreading rate (DFT) and VOC content limits for each separate coat for each type of substrate indicated.
- B. Sustainable Design Submittals: Refer to Division 01 Section "Sustainable Design Requirements."
- C. Samples for Initial Selection: For each type of topcoat product.
- D. Samples for Verification: Submit three samples for each type of coating system and each color and gloss of topcoat indicated.
  - 1. Submit Samples on rigid backing, 12 inches square.
    - a. Cured high-performance coating, 60 mils thick.
    - b. Reinforced fabric and joint cover sheet.
    - c. Ferrous and Nonferrous Metal: Provide two 4 inch square samples of flat metal and two 8 inch long samples of solid metal for each color and finish.
  - 2. Step coats on Samples to show each coat required for system.
  - 3. Label each coat of each Sample with the following:
    - a. Paint color name and number.
    - b. Paint brand name.
    - c. "P" number if applicable, and application area.
- E. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations and VOC content.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Applicator's Project References: Submit list of completed projects.

- B. Certificate of Applicator's Supervisor: Submit certificate indicating completion of manufacturer's certified training program.

### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents for single component products. All 2 component products supplied will be un-catalyzed.

### 1.6 QUALITY ASSURANCE

- A. Contractor shall provide verification of conformance with this specification, referenced standards and related documents. This verification to be performed by a Third Party, minimum NACE Level 1 Certified Coatings Inspector.

- 1. Provide documentation verifying inspector's certification is both valid and current.

- B. Qualifications:

- 1. Applicator: Use applicator experienced in the application of the specified high-performance coating for a minimum of 2 years on projects of similar size and complexity. Provide a list of completed projects including project name and location, name of Architect, name of coating manufacturer, and approximate quantity of coating applied.
  - 2. Applicator's Supervisor: Employ a supervisor during all phases of the work that has successfully completed manufacturer's contractor training program.
  - 3. Applicator's Personnel: Employ persons trained for the application of high-performance coating.

- C. Regulatory Requirements: Comply with environmental regulations.

- 1. Air Quality Standards: Comply with the IBC and local jurisdiction for air quality regulations and chemical and heavy metal components.
  - 2. Performance and Durability:
    - a. Reflectometry.
    - b. ASTM D 4828 Standard Test Method for Practical Washability of Organic Coatings.

- D. Pre-Application Meeting:

- 1. Convene a pre-application meeting two weeks before the start of application of the high-performance coating.
  - 2. Require attendance of parties directly affecting work of this Section, including the Contractor, subcontractor, Architect, Building Envelope Consultant, applicator and manufacturer's representative.

3. Review environmental requirements, materials, and protection of adjacent work, surface preparation, application, curing, field quality control, cleaning, and coordination with other work.
- E. Mockups: Apply benchmark samples of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each coating and substrate.
    - a. Horizontal and Vertical Surfaces: Provide samples of at least 100 sq. ft..
    - b. Other Items: Architect will designate items or areas required.
  2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
  3. Final approval of color selections will be based on benchmark samples.
    - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.
  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.

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

- A. Store materials in accordance with manufacturer's written instructions and acceptable ranges published in their PDS/TDS and SDS sheets.
1. 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.
  2. Maintain containers in clean condition, free of foreign materials and residue.
  3. Remove rags and waste from storage areas daily.

## **1.8 PRE-JOB CONFERENCE**

- A. A pre-job conference to review and clarify the specification is recommended.
- B. Those attending the meeting shall consist of, at minimum, Contractor, Owner (or Owner's Representative), Coatings Inspector (if applicable), and Architect.
- C. Should certified coatings inspection be required as part of the specifying documents; a pre-job conference shall become a mandatory part of the Project.
- D. Attendees of this mandatory meeting must include all parties identified above.

## **1.9 FIELD CONDITIONS**

- A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above dew point; or to damp or wet surfaces.
  - 1. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before proceeding with or continuing coating operations.
  - 2. Work may continue during inclement weather if areas and surfaces to be coated are enclosed and temperature within the area can be maintained within limits specified by manufacturer during application and drying periods.
- C. Do not apply over substrates that are frozen or contain frost.
- D. All bare/exposed steel shall be coated within 8 hours of surface preparation.
- E. Painting contractor should follow proper painting practices in accordance with SSPC-PA1 and ensure environmental conditions are within range of acceptability as documented in manufacturers Product Data Sheets/Technical Data Sheet (PDS/TDS).
- F. Should NACE Certified Coatings Inspection be part of this contract; field conditions shall be verified at the beginning of shift, and three additional times throughout the shift.

## **1.10 WARRANTY**

- A. Provide a 5 year material warranty and 1 year labor warranty.

## **PART 2 - PRODUCTS**

### **2.1 PAINT, GENERAL**

- A. Material Compatibility: Systems could fail if paints used for individual coats are incompatible. Paint systems match primers and topcoats and take compatibility into consideration.
  - 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.
  - 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.

- B. VOC Content: Paints and coatings to be applied at Project Site shall comply with applicable VOC limits of the South Coast Air Quality Management District Rule 1113: Architectural Coatings, exclusive of colorants added to tint bases, as calculated in accordance with 40 CFR 59 Subpart D (EPA Method 24), as follows:
1. Flat Coatings: 50 g/L.
  2. Nonflat Coatings: 50 g/L.
  3. Nonflat - High Gloss Coatings (default Nonflat): 50 g/L.
  4. Floor Coatings: 50 g/L.
  5. Industrial Maintenance (IM) Coatings: 100 g/L.
  6. Pre-Treatment Wash Primers: 420 g/L.
  7. Primers, Sealers, and Undercoaters: 100 g/L.
  8. Rust Preventative Coatings: 100 g/L.
  9. Waterproofing Concrete/Masonry Sealers: 100 g/L.
  10. Zinc-Rich IM Primers 100 g/L.
  11. All Shop-Primed Metal to be coated in accordance with applicable federal, state, and local regulations.
- C. Colorants: The use of colorants containing hazardous chemicals, such as ethylene glycol, and shall comply with the applicable VOC limits of Rule 1113, as follows:
1. Colorants for Architectural Coatings, excluding IM Coatings: 50 g/L.
  2. Colorants for Solventborne Industrial Maintenance Coatings: 600 g/L.
  3. Colorants for Waterborne Industrial Maintenance Coatings: 50 g/L.
- D. Colors: As indicated in a color schedule.
1. When the final color has not been selected prior to bid submittal, Contractor may need to bid additional coats when submitting their bid. The Owner should be aware that if a color is chosen following the bid process and the color is significantly different from original color, a change order for an additional finish coat might be required.

## 2.2 HIGH-PERFORMANCE COATINGS, GENERAL

- A. Material Compatibility:
1. Provide materials for use within each coating 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. Provide products of same manufacturer for each coat in a coating system.
- B. Primer: Recommended by coating manufacturer for system specified for each condition and substrate.

## 2.3 SOURCE QUALITY CONTROL

- A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. The Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

## 2.4 MANUFACTURERS

- A. Carboline Company.
- B. International Protective Coatings; an AkzoNobel Brand.
- C. PPG Protective and Marine Coatings (PPG).
- D. Sherwin Williams Company Protective and Marine Coatings, (SW).
- E. Tnemec Company, Inc.

## 2.5 EXPOSED STEEL (HPC-02)

- A. Field Applied Fluoropolymer, Pigmented:
  1. Primer:
    - a. PPG; Coraflon, ADS Zinc Rich Epoxy, 3.0-3.0 mils (75-100 microns) DFT.
    - b. SW; Zinc-Clad III HS, B69A100-15, 3.0-5.0 mils (75-125 microns) DFT.
    - c. Tnemec; Series 90-97 Tneme-Zinc, 2.5-3.5 mils (65-90 microns) DFT.
  2. Intermediate Coat:
    - a. PPG; Coraflon, Epoxy Intermediate Primer, ADS573/ADS574, 2.0-5.0 mils (50-125 microns) DFT.
    - b. SW; Macropoxy 646, Fast Cure Epoxy, B58 Series, 3.0-10.0 mils (125-175 microns) DFT.
    - c. Tnemec; Series 73 Endura-Shield, 2.0-5.0 mils (50-125 microns) DFT.
  3. Topcoat: Polyurethane, two component, pigmented, semi-gloss or satin.
    - a. PPG; Coraflon ADS, 1.5-2.2 mils, DFT.
    - b. SW; Flurokem HS (Gloss B65-580, Semi-Gloss B65-570, Satin B65-560) at 2.0-3.0 mils (50-75 microns) DFT.



- c. Tnemec; Series 1070 Fluornar, 2.0-3.0 mils (50-75 microns) DFT.

## 2.6 GALVANIZED STEEL (HPC-05)

### A. Polysiloxane over Epoxy System:

1. Primer: Epoxy for galvanized steel.
  - a. Carboline; Rustbond 1.0-2.0 (25-50 microns) DFT.
  - b. International; Intergard Interplus 251, 2-3.0 mils (50-75 microns) DFT.
  - c. PPG; PMC Amerlock 2AL Aluminum Epoxy Mastic, 4.0-8.0 mils (100-200 microns) DFT.
2. Topcoat: Polysiloxane, two-component, pigmented, gloss) <250 g/L.
  - a. Carboline; Carboxane 2000 3.0-7.0 mils (76-178 microns) DFT.
  - b. International; Interfine 878, 2.0-3.0 (50-75 microns) DFT.
  - c. PPG; PMC PSX 700, 3.0-7.0 mils (75-175 microns) DFT.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
  1. Confirm shop applied primer is not a temporary protective primer intended for shipping purposes.
  2. Confirm primer is suitable for anticipated service conditions.
  3. Confirm primer's ability for being top coated with specified materials.
- C. Verify environmental conditions are within coating manufacturer's specified range. Environmental conditions shall be monitored at 4 points throughout each shift. Once at beginning, once at end, and two additional times in between. Recording must be taken at area where work is being performed.
- D. Each set of environmental readings shall consist of:
  1. Relative humidity.
  2. Unless otherwise stated; relative humidity must not exceed 85%.
  3. Ambient Air Temperature.
  4. Dew Point.
  5.  $\Delta??$  - (+/-Difference between surface temperature and dew point) Surface must be a minimum of 5 deg F above dew point

- E. Dust levels remaining on surface shall be verified in accordance with ISO 8502-3. A dust level 3 or cleaner shall be deemed as acceptable.
- F. Surface profile shall be verified in accordance with ASTM D 4417. Surface profile ranges must be within ranges listed in manufacturers published data.
- G. Proceed with coating application only after unsatisfactory conditions have been corrected. Commencement of coating application constitutes Contractor's acceptance of substrates and conditions.
  - 1. Verify compatibility with, and suitability of, substrates, including compatibility with existing finishes or primers.
  - 2. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
  - 3. Coating application indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates indicated. Recommendations shall be verified to meet site conditions during the preconstruction conference.
- B. Remove plates, machined surfaces, and similar items already in place and not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
  - 1. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
- D. Remove incompatible fillers and reprime substrate with compatible primers or apply the coat as required to produce coating systems indicated.
- E. Steel Substrates:
  - 1. All oil, grease, dirt, dust and other foreign materials must be removed prior to surface preparation commencement.
- F. Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
  - 1. Prepare surface per SSPC SP6 "Commercial Blast Cleaning" minimum. Surface profile shall be 1.0 to 1.5 mils.
  - 2. Prior to coating, solvent wipe substrate to remove dust and residual contamination.
- G. Galvanized-Metal Substrates:

1. 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 coatings.
  2. Blast clean new galvanized metal substrate to receive field-applied fluoropolymer coating to SSPC-SP7/NACE NO. 4, "Brush-Off Blast Cleaning," to surface profile of 1.0 to 2.0 mils. Remove all passivator residue.
  3. Clean weathered galvanized metal substrate to receive field-applied fluoropolymer coating to:
    - a. SSPC-SP7/NACE No. 4. "Brush-Off Blast Cleaning,"
    - b. To a surface profile of 1.0 to 2.0 mils.
- H. Material Preparation: Carefully mix and prepare coating materials according to manufacturer written instructions.
1. Maintain containers used in mixing and applying coatings in a clean condition, free of foreign materials and residue.
  2. Stir materials before applying to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into the material. Remove film and, if necessary, strain coating material before using.

### 3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions.
1. Use applicators and techniques suited for coating and substrate indicated.
  2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
  3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.
- E. Application: Apply first coat to surfaces that have been cleaned, pretreated, or prepared for coating as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required is the same regardless of application method.
2. Minimum Coating Thickness: Apply each material no thinner than manufacturer recommended spread rate. Provide total dry film thickness of system recommended by manufacturer.
  - a. DFT ranges per coat must fall within manufacturer's recommended ranges. Measurements shall be taken in accordance with SSPC-PA2 "method for evaluating DFT."

### **3.4 FIELD QUALITY CONTROL**

- A. Testing of Paint Materials: The Owner reserves the right to invoke the following procedures at any time and as often as the Owner deems necessary during the period when paints are being applied.
  1. The Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to the site will be taken, identified, sealed and certified in presence of Contractor.
  2. Testing agency will perform tests for compliance of paint materials with product requirements.
  3. The Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from the site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.
- B. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
  1. Contractor shall touch up and restore coated surfaces damaged by testing.
  2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

### **3.5 CLEANING AND PROTECTION**

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

- C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

**END OF SECTION**

## **SECTION 09 96 23 - GRAFFITI-RESISTANT COATINGS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes penetrating graffiti-resistant coatings for the following vertical and horizontal surfaces:
  - 1. Cast-in-place concrete.
  - 2. Concrete unit masonry.
  - 3. Portland cement plaster (stucco).

#### **1.2 DEFINITIONS**

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
  - 1. Include manufacturer's printed statement of VOC content.
  - 2. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified Applicator.
- B. Product Certificates: For each type of graffiti-resistant coating, from manufacturer.
- C. Preconstruction Testing Reports: For graffiti-resistant coating-treated substrates.
- D. Field quality-control reports.
- E. Warranty: Special warranty specified in this Section.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: Manufacturer's written instructions for removing graffiti and maintaining graffiti-resistant coating.

## 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. Coatings: 5 percent, but not less than 1 gal. of each material and color applied.
- B. Furnish manufacturer's proprietary cleaner, if required for removal of graffiti, that is packaged with protective covering for storage and identified with labels describing contents.
  - 1. Cleaner: 1 gal..

## 1.7 QUALITY ASSURANCE

- A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.
- B. Regulatory Requirements: Product is approved by the following regulatory agency:
  - 1. CalTrans.
  - 2. The Nevada Department of Transportation (NDOT).
  - 3. Los Angeles Department of Building and Safety (LADBS).
- C. Mockups: Apply graffiti-resistant coating to each type of substrate required.
  - 1. Locate each test application as directed by Architect.
  - 2. Size: 10 sq. ft..
  - 3. Final approval by Architect of graffiti-resistant coating application will be from test applications.

## 1.8 PRE-CONSTRUCTION TESTING

- A. Pre-construction Testing: Installed graffiti-resistant coatings shall comply with performance requirements indicated, as evidenced by reports based on Project-specific preconstruction testing of existing substrate assemblies by a qualified testing agency.
  - 1. Select sizes and configurations of assemblies to adequately demonstrate capability of graffiti-resistant coating to comply with performance requirements.
  - 2. In addition to verifying performance requirements, use test applications to verify manufacturer's written instructions for application procedure and optimum rates of product application to substrate assemblies.
  - 3. Notify Architect seven days in advance of the dates and times when assemblies will be tested.

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

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

## **1.10 FIELD CONDITIONS**

- A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
1. Concrete surfaces and mortar have cured for not less than 28 days.
  2. Painted and stucco surfaces have cured for not less than 14 days.
  3. Building has been closed in for not less than 30 days before treating wall assemblies.
  4. Ambient temperature is above 50 deg F and below 90 deg F and will remain so for 24 hours.
  5. Substrate is not frozen and substrate-surface temperature is above 50 deg F and below 90 deg F.
  6. Rain or snow is not predicted within 36 hours.
  7. Not less than 24 hours have passed since surfaces were last wet.
  8. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

## **1.11 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree to repair or replace materials that fail as a result of workmanship or material deficiency as specified in "Performance Requirements" Article within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. System Physical Properties: Provide graffiti-resistant coating with the following minimum physical property requirements when tested according to test methods indicated:
1. Tensile Strength: 5950 psi per ASTM D 412-06a.
  2. Abrasion Resistance: 45 mg maximum weight loss per ASTM D 4060.



3. Water Vapor Transmission: Minimum 5.5 percent water-vapor transmission in comparison of treated and untreated specimens, according to ASTM D 1653.
  4. Graffiti Resistance: Exceeds performance requirement for Level 3 per ASTM D 6578.
  5. Outdoor Weathering: 8000 hours per ASTM G 155-05a.
  6. Cyclic Weathering: No blistering, cracking, checking, softening or delamination per AASHTOR-31. Maximum change of 10 gloss level.
- B. System Chemical Resistance: Test specimens of graffiti-resistant coatings are unaffected when tested according to ASTM D 1308 for 50 percent immersion in the following reagents:
1. MEK Double Rubs: Not less than 300 cycles (Level 5).
  2. Skydrol, Brake Fluid, Gasoline and Motor Oil: No effect after seven days.
  3. Betadine, 50 Percent NaOH, 14 Percent NH<sub>4</sub>OH, 10 Percent Acetic Acid, 10 Percent H<sub>2</sub>SO<sub>4</sub>, 10 Percent HCL, 10 Percent Bleach, and DI Water: No effect after 24 hours.
  4. IPA and Toluene: No effect after four hours.

## 2.2 PENETRATING WATER REPELLENTS

- A. Proprietary Blends: Clear, penetrating, breathable, UV-resistant, water-, oil- and graffiti-resistant treatment. Coatings shall not darken or discolor the treated surfaces and shall be non-toxic, compatible with all standard polymer type sealing materials, and certified by manufacturer as suitable over indicated finishes.
1. VOC Requirements: Provide sealer that has a VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Durability: Non-sacrificial.
  3. Graffiti Removal: With water or proprietary cleaner.
  4. Sheen: Gloss level 1.
  5. Basis-of-Design Product: Subject to compliance with requirements, provide Monopole, Inc.; Permashield Premium 5600 over Permashield Base 6100 or comparable system by one of the following:
    - a. Chemprobe Coating Systems, L.P.
    - b. Dunn-Edwards Coatings
    - c. Evonik Degussa Corp.
    - d. PROSOCO, Inc.
- B. Cleaner (if required for removal of graffiti): Manufacturer's recommended proprietary cleaner that does not contain methanol, methylene chloride, or other prohibited solvents, and may be applied by brush, roller, or sprayer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.

1. Verify that surfaces are clean and dry according to coating manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
  2. Inspect for previously applied treatments that may inhibit penetration or performance of graffiti-resistant coating.
  3. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of graffiti-resistant coating.
  4. Verify that required repairs are complete, cured, and dry before applying graffiti-resistant coating.
  5. Verify compatibility with curing compounds, patching materials, repair mortar, paints, sealants, to be used on masonry surfaces to ensure compatibility with the graffiti-resistant coating.
- B. Test pH level according to graffiti-resistant coating manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Cleaning: Before application of graffiti-resistant coatings, clean substrate of substances that could impair penetration or performance of product according to graffiti-resistant coating manufacturer's written instructions.
- B. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of graffiti-resistant coatings. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of graffiti-resistant coatings being deposited on surfaces. Cover live vegetation.
- C. Coordination with Mortar Joints: Do not apply graffiti-resistant coatings until pointing mortar for joints adjacent to surfaces receiving graffiti-resistant coatings treatment has been installed and cured.
- D. Coordination with Sealant Joints: Do not apply graffiti-resistant coatings until sealants for joints adjacent to surfaces receiving graffiti-resistant coating treatment have been installed and cured.
1. Graffiti-resistant coatings work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, graffiti-resistant coatings, and sealant materials identical to those required.

### 3.3 APPLICATION

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of graffiti-resistant coatings and to instruct Applicator on the product and application method to be used.

- B. Apply clear base coat to unpainted surface. Allow to dry before applying top coat.
- C. Apply graffiti-resistant coating on surfaces indicated for treatment, using 15 psi- pressure spray with a fan-type spray nozzle to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.
- D. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

### **3.4 FIELD QUALITY CONTROL**

- A. Testing of Graffiti-Resistant Coating Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when graffiti-resistant coating is being applied:
  - 1. Owner will engage the services of a qualified testing agency to sample graffiti-resistant coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
  - 2. Testing agency will perform tests for compliance of graffiti-resistant coating material with product requirements.
  - 3. Owner may direct Contractor to stop applying graffiti-resistant coating if test results show material being used does not comply with product requirements. Contractor shall remove noncomplying material from Project site, pay for testing, and correct deficiency of surfaces treated with rejected materials, as approved by Architect.

### **3.5 CLEANING**

- A. Immediately clean graffiti-resistant coating from adjoining surfaces and surfaces soiled or damaged by graffiti-resistant coating application as work progresses. Correct damage to work of other trades caused by graffiti-resistant coating application, as approved by Architect.
- B. Comply with manufacturer's written cleaning instructions.
- C. After application is complete, remove protective coverings from adjacent surfaces and other protected areas.

### **3.6 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to remove graffiti from each type of surface where graffiti-resistant coatings are applied.

**Gensler**  
005.2882.000

January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

**END OF SECTION**

## SECTION 10 14 00 – CAMPUS SIGNAGE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes campus signage in accordance with Long Beach City College standards.

#### 1.2 SUBMITTALS

- A. Provide the following submittals:
  - B. Shop Drawings
    - 1. Provide three (3) sets of shop drawings for each sign type in the Design Drawings for review and written approval prior to fabrication.
    - 2. Shop Drawings shall include the following:
      - a. Shop instruction drawing on vendor's title block showing exactly how the sign will be made: exact materials; techniques; processes; dimensions; internal structure; lighting fixtures; ballast and wiring; welds; connections; fasteners; mounting details; access panels and other pertinent information.
      - b. Include message listing with all forms, symbols and text to be used Message listing to correspond to numbering system shown on Signage Design Drawings.
      - c. Include engineering calculations, soils report and data for all components of stress. Contractor to obtain and submit preliminary soils report to owner for approval prior to fabrication. A.O.R. or College to provide soils report for footing engineering drawings when available.
      - d. Structural shop drawings shall be signed and stamped by a California licensed structural engineer from Sign Contractor. Electrical shop drawings shall be signed and stamped by a California licensed electrical engineer from Sign Contractor.
  - C. Calculations
    - 1. Prior to fabrication, provide engineer stamped calculations for all foundations, lifting eyes and other components that affect the structural design.
  - D. Patterns
    - 1. Provide three (3) full size, paper pattern for all signs with painted, curved, stenciled, cutout, fabricated, routed or sandblasted letters, characters, forms or other as noted on drawings for review and approval. Identify each pattern with the sign number to which the pattern applies.
    - 2. Pattern definition: Full size exact outline on white paper of each letter, word, character, or form. Include outline of sign panel. Make outlines dark enough for long distance viewing.

3. These patterns, once accepted, will become the patterns or templates for shop fabrication.
4. Retain all original annotated patterns reviewed during pattern submittal process.
5. Retain final approved/stamped pattern for use and review at installation.

E. Colors and Material Samples

1. Submit samples for review and approval. Identify each sample with the sign type number to which the sample applies.
  - a. Paint samples, 8 1/2" x 11", on actual specified materials to match color, texture and finish.
  - b. Each type exposed metal used for major elements of work with respective finish.
  - c. Each type plastic (acrylic, polycarbonate, PVC) used for major elements of work with respective finish.
  - d. Each type adhesive plastic film, including die-cut designs.
  - e. Each type adhesive vinyl, including opaque and reflective.
  - f. Decorative hardware, including bolt heads, nail heads, screw heads, rivets and similar exposed items.
  - g. Compile and maintain a listing of all paint colors with the factory batch number and formulation code for all paints and coatings. For custom semi- opaque and/or "wash" type finishes, provide specific mix "reduced" formulations. Submit the list to the Owner for future maintenance reference.

F. Three (3) copies of Manufacturer's Certificates of Material Standards to meet all Code and Ordinance Requirements.

G. Artwork:

1. Sign Contractor to provide all sign type artwork, including films, typesetting, variations in required evacuation map art with graphic images, all city and state required forms of artwork for fire, safety and occupancy related signage. Contractor artwork to be generated based on samples of template electronic art files provided as guides for actual production art. Provide the editable files format, upon final approval from the District.

### 1.3 QUALITY ASSURANCE

A. Comply with all laws, ordinances, rules, regulations and orders of any public authority having jurisdiction over this work.

B. Preparation:

1. Protect exposed finish surfaces of hanging items from damage resulting from fabricated hanging/support assemblies.
2. Prepare hanging items to receive proper attachments in accord with Contract Drawings and approved submittals. Install work in accord with approved shop drawings, patterns and color/material submittals.

#### **1.4 MAINTENANCE – MATERIALS AND DOCUMENTATION**

- A. Upon completion of work, Contractor is to provide written documentation outlining proper care and maintenance for all graphic materials, colors, finishes and hardware.
- B. Touch-up paint: Provide Owner with one 1/2 pint can of touch-up paint (including clearcoat finish) of each type and color used in work.
- C. Provide warranty as follows:
  - 1. Warrant all work against failure because of faulty materials, workmanship, and design for a period of one year from date of acceptance by the Owner.
  - 2. Fading, cracking, warping, peeling, delaminating, rusting, corroding and structural failure, including distortion by whatever cause, shall be construed to mean failure because of faulty materials and workmanship.
  - 3. Failures during the warranty period shall be repaired or replaced to the satisfaction of, and without any cost to the Owner.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- A. The work as herein identified, requires the manufacture and/or purchase of; and delivery, installation and/or application of: Signage and Graphics as part of the Long Beach City College Campus-Wide Wayfinding Program.

#### **2.2 MATERIALS – METALS**

- A. Steel (exterior):
  - 1. Exposed, painted locations and bending/formed uses: Stretcher-leveled, electrolytic zinc-coated, sheet steel, with phosphate or other specialty treatment for maximum paint adherence, ASTM A591, commercial or drawing quality, Coating Class C.
  - 2. Concealed, unpainted locations and flat/unformed uses: Galvanized sheet steel, ASTM A653, commercial quality, with G90 coating.
  - 3. Steel shapes: ASTM A36, A53, A500, A501 hot-rolled or cold rolled shapes, plates and tubes in sizes indicated on Design Drawings.
- B. Aluminum (exterior):
  - 1. Sheet Aluminum ASTM B209: Provide alloy and temper consistent with specific fabrication and finishing processes.
  - 2. Extruded aluminum: Provide alloy and temper consistent with specific fabrication and finishing processes.
  - 3. Bars, rod, wire and shapes: ASTM B221

4. Pipe and tubing: Seamless, minimum Schedule 40 or equivalent wall thickness
  - a. Non-structural: ASTM B210 and ASTM B241.
  - b. Structural: ASTM B429.
- C. Metal thickness: Provide metal thickness indicated on Design Drawings. When metal thickness is not indicated on Design Drawings, provide thickness most appropriate for the fabrication condition.
  1. For sheet steel not indicated, use not less than 20 gauge. For non-ferrous metal not indicated, use not less than 0.032-in. thickness.

### 2.3 MATERIALS – SCREEN PRINTING (exterior)

- A. Opaque Inks:
  1. Provide opaque ink as manufactured by:
    - a. Matthews Paint Company
    - b. 3M Products, Inc.
    - c. Or equal.
  2. Opaque inks: Multi-component, catalyzed, thermosetting, ultraviolet-curing, or similar high performance, chemical-resistant, colorfast screening inks. Provide specific types/versions suited for specific/intended applications as recommended by screening ink manufacturer (e.g., ultraviolet-resistant for exterior applications, flexible for fabric and similar soft substrates).
- B. Transparent inks: As manufactured by 3M or equal.
- C. Screen material for screen printing process:
  1. Stainless steel, nylon or polyester with 250 lines per inch, or finer.
  2. Use 16 XX screen for printing on cloth fabric.
  3. Screen Printing for 3M retro reflective sheeting Series 3970:
    - a. 3M Ink Series 880 (no known equal)
    - b. Series 880 process colors can be screen processed at 60-100 F at relative humidity of 20-50%. Use of PE 157 screen mesh with a fill pass.

### 2.4 MATERIALS – ADHESIVE FILM (EXTERIOR)

- A. Vinyl die-cut: Precision-cut, pre-spaced, computer-generated, pressure-sensitive type by 3M or equal. Refer to Design Drawings for specified type and grade.



## 2.5 MATERIALS – ANTI GRAFFITI FINISHES

### A. Anti-Graffiti Coatings - General

1. Coatings shall consist of a solvent based, water resistant, highly durable application that can be sprayed, rolled or brushed onto any architectural or sign surface, such as concrete, plaster, brick, wallboard, steel, aluminum or wood. Once applied and cured, all coatings must also be impervious to damage by graffiti removers or cleaners. Coating and cleaner compatibility is paramount. The coating must come in low gloss or glossy and meet the following specifications as manufactured by Tradewinds International Inc, Ameron Coatings or approved substitution.

### B. Anti-Graffiti Coatings - Application

1. Protective Coating: Must be applied to clean, dry surface, bare or previously painted, including graffiti paint. No grease, oil, dirt, dust, silicon or any loose foreign material may be on the surface to be coated.
  - a. Cleaning protocols
  - b. Steel - Sand or bead blast to gray metal. Prime or apply topcoat direct- to-metal (dtm) before flash rust.
  - c. Concrete & brick - High-pressure water wash 1,500 psi or higher. Allow dry time.
  - d. Plaster & Wall Board - Plaster and taping compound must dry completely. Wash down must follow any sanding.
  - e. Aluminum - Clean with solvent in small, manageable areas. All oil, grease, silicon, etc., must be adequately removed and the solvent completely evaporated before application.
  - f. Wood - Recently installed dry wood is usually clean. Old wood, any grease or oil spots should be sanded down to dry clean wood.
  - g. Painted Surfaces - Old paint should be chemically cleaned and etched with TSP or equivalent to remove oxidation, dirt, oil, grease, etc., and then properly dried before coating application. Testing for paint and coating compatibility is recommended.

### C. Anti-Graffiti Coatings - Removal

1. The graffiti remover must have the following characteristics: be easily sprayable by trigger or pump applicator; be of sufficient thixotropic or gelatinous consistency to hang on vertical or overhead surfaces without running; rinse off easily with water; be completely biodegradable; be non-toxic; be non-flammable; contain no petroleum distillates; and contain no ingredients classified as hazardous by any state or federal agency.
2. Spray affected area only. Use natural bristle brush or cloth to agitate compound into graffiti. Remove all material from surface with damp cloth or water spray, depending on surface. Repeat procedure if necessary.

### D. Anti-Graffiti Sheeting - General

1. Sheeting shall be a matching component system consisting of a high performance protective transparent overlay for use on signs made from 3M sheeting, films and images.
2. Series 1160 or 1160A, a durable, solvent resistant, transparent, fluoropolymer film coated with a transparent pressure-sensitive adhesive as manufactured by 3M, Calon or approved substitution

## 2.6 MATERIALS – CONCRETE

### A. Materials;

1. Portland Cement: ASTM C 150, Type I or Type III, Color to be as required to achieve proper color as determined by the Architect.
2. Coarse Aggregate: ASTM C 33, except for gradation. Color to be white. Darker aggregates may be used as long as the proper color mix is achieved as determined by the Architect.
3. Fine Aggregate: ASTM C 33, except for gradation. Color to be white. Darker aggregates may be used as long as the proper color mix is achieved as determined by the Architect.
4. Pigments: ASTM C 979; Inorganic, nonfading, resistant to lime and other alkalis. Pigments not to exceed 10% of the cement weight.
5. Water: Drinkable, free from foreign materials in amounts harmful to concrete or cast in steel.
6. Air-Entraining Admixture: ASTM C 260.
7. Water-Reducing, Retarding, or Accelerating Admixtures: ASTM C 494, type as selected by Fabricator and containing not more than 0.1 percent chloride ions.
8. Reinforcement: New billet steel reinforcing bars, as necessary for safe handling, setting and structural stress. Size of the reinforcing shall be specified with a minimum area of steel equal to one quarter of one percent of the concrete's cross section area. If the surfaces are to be exposed to the weather, the reinforcement shall be galvanized or epoxy coated when covered with less than 2 inches of material for bars larger than 5/8 inch and 1-1/2 inches for bars 5/8 inch or smaller. The material covering in all cases shall be at least twice the diameter of the bars.
  - a. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
  - b. Epoxy-Coated Reinforcing Bars: ASTM A 775.
  - c. Galvanized Reinforcing Bars: ASTM A 767, Class II (2.0 oz. zinc psf), hot-dip galvanized after fabrication and bending.
  - d. Welded Wire Fabric: ASTM A 185.
  - e. Anchorages: The Setting Contractor is to provide all loose hardware (dowels, anchors, plates, etc.) necessary for securing precast units to supporting and/or adjacent members. Anchors to be non-corrosive; galvanized, brass or stainless steel type 304.

### B. Mix Properties:

1. Minimum 5000 psi compressive strength at 28 days using 6" x 12" cylinders per ASTM C39-86; Total Air Content not less than 4% nor more than 8%; Water Absorption is not to exceed 6% by weight when tested per ASTM C 642.

C. Surface Finish:

1. Remove all surface cement paste by means of acid etching to provide a smooth, dense, fine-grained texture with no streaks or blotches. Texture and quality of finish to be generally equal to the approved sample when viewed in direct daylight at a 10 foot distance.

### **PART 3 - EXECUTION**

#### **3.1 FABRICATED LETTERS, NUMBERS AND SHAPES**

- A. Provide materials and workmanship that is performed by skilled craftsman under the supervision of trained foremen, experienced in the trade or craft required to accomplish the work and produce a product of high quality.
- B. Where neon or "halo"-type illumination is indicated, interior surfaces of formed (channel) letters and shapes shall be finished with synthetic enamel, white color.
- C. Where internal or halo-type illumination is indicated, fabricate letters and shapes with internal support system to secure letters and shapes to supporting surface and also allow easy, quick removal for maintenance of illumination components. Internal system must not cast shadows nor obstruct illumination as to be visibly apparent when fully illuminated letters and shapes are viewed from the front.
- D. Finish exposed edges to match finish of face, free of finishing marks.
  1. Finish: Polyurethane enamel, directionally brushed, or mirror polished as indicated.

#### **3.2 ACRYLIC LETTERS AND SHAPES:**

- A. Precision-milled single-piece or routed letters and shapes. Polish exposed edges to match finish of face, free of polishing markings, unless indicated otherwise. "Punched thru" portions must fit accurately into routed portions of cabinet with tight, hairline joints and snugly into back of formed (channel) letters.
- B. Evidence of laminating process of letters and shapes to carrier or diffuser, including the carrier itself, must not be visible on face of signs when internally illuminated. Provide continuous opaque masking material at perimeter of routed opening.
- C. Maintain protective paper covering on exposed faces during fabrication wherever possible. Remove immediately prior to Owner's review of completed sign fabrication.
- D. Coordinate fabrication of sheet plate and formed (channel) letters and shapes, and routing of sign cabinets to assure a tight, hairline type joint between materials.

- E. Fabricate laminated acrylic plastic and sheet plate letters and shapes to assure precise, matching shapes and forms with tight, hairline joint.

### **3.3 PAINTING AND FINISHING**

- A. Definitions:
  - 1. The term "paint" as used herein includes enamels, polyurethanes, paints, primers, sealers, fillers, stains, and coatings systems whether used as prime, intermediate or finish coats.
  - 2. The term "system" implies that each finish is comprised of materials and quantities appropriate for the surface to be finished, and includes preparation priming/sealing, and intermediate and finish coats as applicable.
- B. Sample finishes: Refer to Section 1.3 - "SUBMITTALS".
- C. Paint color references: As indicated on Design Drawings.
- D. Paint formulation: All paint materials shall be especially formulated to meet all local and state environmental codes and specifications, with anti-mildew agents incorporated into the formulations. This requirement applies to all materials including those for interiors of sign cabinets and cans. In addition, include carefully balanced ultraviolet inhibitors for exterior materials.
- E. Application:
  - 1. Properly prepare subsurfaces and apply materials in an environment most favorable for producing best quality work. Where indicated or necessary, etch surfaces prior to applying finish paint materials.
    - a. Finish surfaces shall be free of streaks, laps, runs, or pile-up of paints, with all surfaces uniformly covered.
    - b. Surfaces with over spray are not acceptable.
  - 2. Unless specified or directed otherwise, provide semi-gloss (specular gloss value of 50 in accord with ASTM D523) finish for all surfaces.
  - 3. Unless specified or directed otherwise, provide "clear coat" finish over all exposed, finish painted surfaces consisting of a two-component catalytic, clear, acrylic polyurethane enamel with ultraviolet inhibitors. Unless otherwise directed by Owner, provide semi-gloss for metal and plastic surfaces and flat/matte gloss for wood surfaces.
  - 4. Seal all edges of plywood and end grain of solid stock wood even though it may be concealed by other work.

### **3.4 FABRICATION - GENERAL**

- A. It is intended that the workmanship be of the highest quality obtainable by the respective trades and crafts experienced in the fabrication of signs

- B. Finished work shall be of highest quality to pass eye-level examination and scrutiny. Scratches, paint drips or sags and other visual defects are not acceptable.
- C. Copy application: Sign copy shall be crisp, sharp, clean, and free from "ticks," discontinuous curves, line waver, and similar type imperfections.
  - 1. Letterforms shall conform to prescribed proportions.
  - 2. Whenever possible, messages shall be set full-size.
  - 3. Letterforms shall be aligned so as to maintain a baseline parallel to sign format, with margins and layout as indicated on Design Drawings and approved shop drawings.
- D. Sign construction:
  - 1. Construct work to eliminate burrs, cutting edges, and sharp corners.
  - 2. Finish welds on exposed surfaces to be imperceptible in the finished work.
  - 3. Except as indicated or directed otherwise, finish surfaces smooth.
  - 4. Surfaces that are intended to be flat shall be without bulges, depressions, oil canning, or other physical deformities; use thicker materials or other means of stiffening or reinforcement to achieve intended results.
  - 5. Surfaces that are intended to be curved shall be smoothly free-flowing to required shapes.
  - 6. Parts indicated to be turned must be accurately machined/worked from solid stock to dimensions indicated or on approved shop drawings. Finished surfaces to be polished smooth unless otherwise indicated, free of any visible pits, voids, or similar defects.
  - 7. Fabricate continuous, internal support/mounting systems required to adequately secure/support signs. Where necessary, make provisions to allow for easy, quick removal for maintenance, etc. Where internal illumination is indicated, internal system must not cast shadows nor obstruct illumination as to be visibly apparent when fully illuminated sign is viewed from front.
  - 8. Except where approved otherwise by Owner, conceal fasteners.
  - 9. Exercise care to assure that finished surfaces are unblemished in completed Work.
  - 10. Isolate dissimilar materials. Exercise particular care to isolate non-ferrous metals from ferrous metals, including fasteners.
  - 11. Fabricating copy: Unless specifically indicated on Design Drawings otherwise, fabricate sign copy as follows.
    - a. Cut-out copy: All letter and number cut-outs shall be made from material and gauge as indicated on Design Drawings. Cutting shall be done in such manner that edges and corners of finished letterforms will be sharp and true. Letterforms with nicked, cut, ragged, rounded (positive or negative) corners, and similar disfigurements will not be acceptable.
    - b. Silk-screened and hand-painted copy: Finish sheen of copy to match sheen of copy panel background (gloss, semi-gloss, or sheens between). Edges of letters shall be straight and corners sharp. Surface of letters shall be uniform in color, finish, and free from pinholes and other imperfections.

- c. Routed copy: Cutting and routing shall be done in such manner that edges and corners of finished letterforms shall be sharp and true. Letterforms with nicked, cut, ragged, rounded (positive or negative) corners, and similar disfigurements will not be acceptable. Letterforms shall be aligned so as to maintain a base line parallel to the sign format, with margins and layout as indicated on Design Drawings and approved shop drawings. Vertical strokes shall be plumb. Mechanically fasten center of letters to acrylic plastic as required.
  - d. Vinyl letters: Vinyl letters and numbers shall be computer cut unless an alternate process is approved by Owner prior to fabrication. Copy shall be pre-spaced with 3-M series 2-application tape, prior to installation on sign. No exceptions.
12. Stainless steel: Fabricate, Machine cut, Plasma cut or Brake-formed, heliarc electric welded construction, precision formed, with straight and even corners and edges. Visible distortions and other irregularities, due to heat of welding process, is not permitted on exposed surfaces. Test welds using dye-penetrant or vacuum-seam tester; reweld where necessary to obtain solid, complete weld joint. Grind welds smooth, flush, and finish to match adjacent surfaces.

### **3.5 INSTALLATION – GENERAL**

- A. Verify and stake the exact sign locations at on site walk-through with BMT/Owner at the job site for all sign locations which are not exactly dimensioned on the drawings. Notify BMT/Owner of any conditions that may adversely affect satisfactory installation of graphic elements.
  - 1. Stake all Directory, Directional and Evacuation Map signs using a paper template matching the actual size and shape of the sign and in similar color.
- B. Except as indicated otherwise on the drawings, install prefabricated work plumb, level, square and true to line.
- C. Securely anchor work in proper location using anchors, anchorages, fasteners, or other methods approved on shop drawings. All anchors and fasteners shall be appropriate to the anchorage condition.
- D. Coordinate work and access to site with the Owner.
- E. Final adjustment and cleaning:
  - 1. Touch-up all scratched, marred, abraded, or otherwise damaged surfaces to match original surfaces.
  - 2. Clean-up work area after installation has been completed.

### **3.6 MATERIAL HANDLING**

- A. Pack, wrap, crate, bundle, box, bag, or otherwise package, handle, transport, and store all fabricated work as necessary to provide protection from damage by every cause.

- B. Provide clear and legible identifying information on all product packaging to ensure proper on-site review and installation.

### **3.7 PROJECT CONDITIONS**

- A. Protection:
  - 1. Warning signs and other methods of protection must be sufficiently substantial to withstand normal, anticipated construction activities and are subject to Owner's approval.
- B. Sequencing/Scheduling: Coordinate fabrication, delivery, installation, field finishing and field-application, where applicable, of the work of this section, with progress of construction and Owner's schedule.

### **3.8 RESTORATION**

- A. Damage due to negligence of the Contractor to surfaces or building components, shall be repaired and restored to its original condition by the Contractor at no extra cost to the Owner. Patch and paint around all cuts to match adjacent surfaces.
- B. Patch and paint around all cuts to match adjacent surfaces. Replace with ceiling, wall or floor tiles affected by the installation with new tiles.

### **3.9 INSPECTION**

- A. Owner reserves the right to inspect work in the fabrication shop in progress and before it is shipped to the job site for installation.
- B. Fabricator shall inspect installation locations for conditions that will adversely affect execution, performance and quality of work, and shall not proceed with installation until unsatisfactory conditions have been corrected.

### **END OF SECTION**

## **SECTION 10 14 23.16 - VINYL WALL GRAPHICS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Field-applied, vinyl-character signs and graphics.
- B. Related Requirements:
  - 1. Section 10 14 73 "Painted Signage" for field-painted graphics.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For field-applied, vinyl-character signs and graphics.
  - 1. Include fabrication and installation details and attachments to other work.
  - 2. Show message list, typestyles, graphic elements, and layout for each sign at least half size.
- C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
  - 1. Field-Applied, Vinyl-Character Signs: Full-size Sample of characters on glass.
- D. Product Schedule: For panel signs. Use same designations indicated on Drawings or specified.

#### **1.3 CLOSEOUT SUBMITTALS**

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

#### **1.4 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

#### **1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.



## 1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Deterioration of finishes beyond normal weathering.
    - b. Deterioration of embedded graphic image.
    - c. Separation or delamination of sheet materials and components.
  2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 FIELD-APPLIED, VINYL-CHARACTER SIGNS AND GRAPHICS

- A. Field-Applied, Vinyl-Character Signs and Graphics: Prespaced characters and graphic elements die cut from 3- to 3.5-mil thick, weather-resistant vinyl film with release liner on the back and carrier film on the front for on-site alignment and application.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allen Markings.
    - b. APCO Graphics, Inc.
    - c. Mohawk Sign Systems.
    - d. Seton Identification Products.
  2. Size: As indicated on Drawings.
  3. Substrate: Glass.
  4. Text and Font: As indicated on Drawings.

### 2.2 MATERIALS

- A. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.

## **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. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
  - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
  - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Field-Applied, Vinyl-Character Signs and Graphics: Clean and dry substrate. Align sign characters in final position before removing release liner. Remove release liner in stages, and apply and firmly press characters into final position. Press from the middle outward to obtain good bond without blisters or fishmouths. Remove carrier film without disturbing applied vinyl film.
- C. Signs and Graphics Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

### **3.3 ADJUSTING AND CLEANING**

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

## **END OF SECTION**

## **SECTION 10 14 73 - PAINTED SIGNAGE**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

A. Section Includes:

1. Field-painted graphics painted directly on substrates in good condition.

#### **1.2 DEFINITIONS**

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For painted graphics.
1. Show graphic locations and dimensions.
- C. Samples: For each type of paint, paint system, color, and gloss; minimum 4 inches long in least dimension; on hardboard.
1. Include stepped Samples defining each separate coat, if any. Resubmit until each required sheen, color, and texture is achieved.
  2. For each painted color being matched to a standardized color-coding system, include the color chips from the color-coding-system company with Samples.
  3. Include a list of materials for each coat of each Sample.
  4. Label each Sample for location and application.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Color Matching Certificate: For computer color matching of colors.

#### **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra paint materials, from the same production run, that match products applied and that are packaged with protective covering for storage and identified with labels describing contents, including material, finish, source, and graphic location on building.
  - 1. Quantity: Furnish Owner with an additional 3 percent, but not less than 1 gal. of each material and color applied.

#### **1.6 QUALITY ASSURANCE**

- A. Color Matching: Custom computer-match paint colors to colors indicated on Drawings.

#### **1.7 FIELD CONDITIONS**

- A. Weather Limitations: Proceed with painting graphics only when existing and forecasted weather conditions are within the environmental limits set by each manufacturer's written instructions and specified requirements.
- B. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- C. Do not apply paint in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
  - 1. Painting may continue during inclement weather if surfaces and areas to have painted graphics are enclosed and heated within temperature limits specified by manufacturer for surface preparation and during paint application and drying periods.

### **PART 2 - PRODUCTS**

#### **2.1 SIGN-PAINT MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Matthews Paint; A Subsidiary of PPG.
  - 2. T.J. Ronan Paint Corporation.

## 2.2 PAINTED GRAPHICS

- A. Painted Wall Graphic : Painted directly on indicated substrate, including primers, sealers, undercoats, and transition coats as required.
  - 1. Paint Type: Latex.
    - a. Gloss: Level 1.
  - 2. Substrate: As indicated on Drawings.

## 2.3 PAINT MATERIALS

- A. Sign Paints and Coatings: Inks, dyes, and paints that are recommended in writing by manufacturer for optimum adherence to substrate and are UV and water resistant for colors and exposure indicated.
  - 1. Compatibility: Provide paint materials 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. Transition Coat: Paint manufacturer's recommended coating for use where a residual existing coating is incompatible with the paint system.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance. Comply with paint manufacturer's written instructions for inspection.
- B. If existing surfaces cannot be prepared to an acceptable condition for proper painting, notify Architect in writing.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and surface is dry.
  - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

### 3.2 INSTALLATION

- A. Appearance Standard: Completed graphic work shall have a sharp and uniformly delineated appearance as viewed by Architect from building exterior at 20 feet away from painted surface.

- B. Comply with manufacturers' written instructions for surface preparation and paint-application for each substrate condition.
- C. Apply a transition coat over incompatible existing coatings and substrate materials.
- D. Apply primers, sealers, undercoats, and transition coats so that they do not extend beyond the limits of the painted graphic. Remove excess without damaging the substrate.

### **3.3 ADJUSTING AND CLEANING**

- A. After completing graphic application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- B. 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.

**END OF SECTION**

## **SECTION 10 26 00 - WALL AND DOOR PROTECTION**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Wall guards.
- B. Related Requirements:
  - 1. Section 08 71 00 "Door Hardware" for stainless-steel mop, kick, armor, and push plates.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each product indicated.
- B. CALgreen Submittals:
  - 1. Product Data for Section 5.504.4.1.1: For sealants, adhesives and caulks, provide documentation including printed statement of VOC content showing compliance with SCAQMD Rule 1168 VOC limits and CCR (California Code of Regulations) Title 17 for aerosols.
  - 2. Product Data for Section 5.504.4.1.2: Provide documentation for aerosol adhesives, and smaller unit sizes of adhesives, sealant, and caulking compounds (in units of product, less packaging, which do not weigh more than one (1) pound and do not consist of more than sixteen (16) fluid ounces) comply with statewide VOC standards and prohibitions on use of certain toxic compounds, of CCR Title 17, commencing with Section 94507.
  - 3. Product Certificate for Section 5.504.4.5: Provide documentation as required in CALgreen Section 5.504.4.5.3, for hardwood plywood, particleboard and medium density fiberboard composite wood products showing compliance with requirements for formaldehyde as specified in ARB's Air Toxics Control Measure (ATCM) for Composite Wood.
- C. Shop Drawings: Include locations and extent of impact-resistant wall protection and details of installation.
- D. Samples: For each unit and for each color and texture required.

#### **1.3 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

#### **1.4 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Furnish full-size units of maximum length, including vinyl plastic cover and aluminum retainer, equal to 2 percent of each type, color, and texture of each type of unit installed, but no fewer than two units.

#### **1.5 QUALITY ASSURANCE**

- A. Fire-Test-Response Characteristics: Provide components with flame-spread and smoke-developed indices of not more than 25 and 450, respectively, when tested per ASTM E 84 by a testing agency acceptable to authorities having jurisdiction.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Basis-of-Design Product: The design for each impact-resistant wall protection unit is based on the product named. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
  - 1. Balco, Inc.
  - 2. Boston Retail Products.
  - 3. Construction Specialties, Inc.
  - 4. IPC Door and Wall Protection Systems, Inc.
  - 5. Koroseal Wall Protection Systems, Inc.
  - 6. Pawling Corporation.

#### **2.2 MATERIALS**

- A. Extruded Plastic: Textured, chemical- and stain-resistant, high-impact-resistant, PVC or acrylic-modified vinyl plastic; thickness as indicated; with a minimum impact resistance of 25.4 ft-lbf/in. of width when tested according to ASTM D 256, Test Method A.
- B. Aluminum Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated, but with not less than the strength and durability properties of ASTM B 221 , alloy 6063-T5.
- C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorroding metal screws, bolts, and other fasteners compatible with aluminum components, hardware, anchors, and other items being fastened. Use vandal-resistant fasteners where exposed to view.



## 2.3 WALL GUARDS

### A. Chair Rails:

1. Basis-of-Design Product: As scheduled on Drawings
2. Installation Height: Wainscot height unless otherwise indicated.

## 2.4 FINISHES

- ### A. Plastic Color: As indicated by named manufacturer's designation.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- #### A. Preparation: Complete finishing operations, including painting, before installing impact-resistant wall protection system components. Before installation, clean substrate to remove dust, debris, and loose particles.
- #### B. Install impact-resistant wall protection system components level, plumb, and true to line without distortions.
1. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- #### C. Where splices occur in horizontal runs of more than 20 feet , splice aluminum retainers and plastic covers at different locations along the run.
- #### D. Immediately on completion of installation, clean plastic covers and accessories using standard ammonia-based household cleaning agent. Clean metal components according to manufacturer's written instructions.

## END OF SECTION

## **SECTION 10 28 00.13 – TOILET AND BATH ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Public-use washroom accessories.
  - 2. Hand dryers.
  - 3. Childcare accessories.
  - 4. Underlavatory guards.
  - 5. Custodial accessories.
  
- B. Related Requirements:
  - 1. Section 08 83 00 "Mirrors" for frameless mirrors.

#### **1.2 COORDINATION**

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
  
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  - 3. Include electrical characteristics.
  
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  - 1. Identify locations using room designations indicated.
  - 2. Identify accessories using designations indicated on Drawings.

#### **1.4 CLOSEOUT SUBMITTALS**

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

#### **1.5 WARRANTY**

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, visible silver spoilage defects.
  - 2. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Hand Dryers: Manufacturer agrees to repair or replace hand dryers 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. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Structural Performance: Design accessories and fasteners to comply with the following requirements:
  - 1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.

#### **2.2 PUBLIC-USE WASHROOM ACCESSORIES**

- A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.
- B. Washroom Accessories:
  - 1. Basis of Design Product: Subject to compliance with requirements, provide the product(s) scheduled on Drawings, or a comparable product by one of the following:
    - a. American Specialties, Inc.
    - b. Bobrick Washroom Equipment, Inc.
    - c. Bradley Corporation.
    - d. GAMCO Specialty Accessories; a division of Bobrick.

- e. Seachrome Corporation.
- f. Tubular Specialties Manufacturing, Inc.

### 2.3 HAND DRYERS

- A. Source Limitations: Obtain each type of hand dryer from single source from single manufacturer.
- B. Warm-Air Dryer :
  - 1. Basis of Design Product: Subject to compliance with requirements, provide the product(s) scheduled on Drawings, or a comparable product by one of the following:
    - a. AJW Architectural Products.
    - b. American Dryer, Inc.
    - c. American Specialties, Inc.
    - d. Bobrick Washroom Equipment, Inc.
    - e. Bradley Corporation.
    - f. Excel Dryer Inc.
    - g. GAMCO Specialty Accessories; a division of Bobrick.
    - h. Saniflow Hand Dryer Corporation.
    - i. Sloan Valve Company.
    - j. Tubular Specialties Manufacturing, Inc.
    - k. World Dryer Corporation.
  - 2. Description: Standard-speed, warm-air hand dryer.
  - 3. Mounting: Semirecessed.
    - a. Protrusion Limit: Installed unit protrudes maximum 4 inches from wall surface.
  - 4. Operation: Touch-button Infrared-sensor activated with timed power cut-off switch.
    - a. Automatic Shutoff: At 40seconds.
  - 5. Maximum Sound Level: 63 dB.

### 2.4 CHILDCARE ACCESSORIES

- A. Source Limitations: Obtain childcare accessories from single source from single manufacturer.
- B. Childcare Accessories:
  - 1. Basis of Design Product: Subject to compliance with requirements, provide the product(s) scheduled on Drawings, or a comparable product by one of the following:
    - a. American Specialties, Inc.
    - b. Bradley Corporation.
    - c. Diaper Deck & Company, Inc.

- d. Foundations Worldwide, Inc.
- e. GAMCO Specialty Accessories; a division of Bobrick.
- f. Koala Kare Products; a Division of Bobrick.
- g. SafeStrap Company, Inc. (SSC, Inc.).
- h. Tubular Specialties Manufacturing, Inc.

## 2.5 UNDERLAVATORY GUARDS

### A. Underlavatory Guard :

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Buckaroos, Inc.
  - b. Plumberex Specialty Products, Inc.
  - c. Truebro by IPS Corporation.
- 2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
- 3. Material and Finish: Antimicrobial, molded plastic, white.

## 2.6 CUSTODIAL ACCESSORIES

### A. Source Limitations: Obtain each type of custodial accessory from single source from single manufacturer.

### B. Custodial Utility Shelf :

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AJW Architectural Products.
  - b. American Specialties, Inc.
  - c. Bobrick Washroom Equipment, Inc.
  - d. Bradley Corporation.
  - e. Brey-Krause Manufacturing Co.
  - f. GAMCO Specialty Accessories; a division of Bobrick.
  - g. Tubular Specialties Manufacturing, Inc.
- 2. Description: With exposed edges turned down not less than 1/2 inch and supported by two triangular brackets welded to shelf underside.
- 3. Size: 16 inches long by 6 inches deep Insert dimensions.
- 4. Material and Finish: Not less than nominal 0.05-inch- thick stainless steel, ASTM A480/A480M No. 4 finish (satin).

### C. Custodial Mop and Broom Holder :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AJW Architectural Products.
  - b. American Specialties, Inc.
  - c. Bobrick Washroom Equipment, Inc.
  - d. Bradley Corporation.
  - e. Brey-Krause Manufacturing Co.
  - f. GAMCO Specialty Accessories; a division of Bobrick.
  - g. Tubular Specialties Manufacturing, Inc.
  - h. Insert manufacturer's name.
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf Insert description.
3. Length: 36 inches Insert dimension.
4. Hooks: Four Insert number.
5. Mop/Broom Holders: Three Insert number, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
  - a. Shelf: Not less than nominal 0.05-inch- thick stainless steel.
  - b. Rod: Approximately 1/4-inch- diameter stainless steel.

## 2.7 MATERIALS

- A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch- minimum nominal thickness unless otherwise indicated.
- B. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch- minimum nominal thickness.
- C. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.
- D. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.
- F. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).
- G. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

## **2.8 FABRICATION**

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
  - 1. Remove temporary labels and protective coatings.

### **3.2 ADJUSTING AND CLEANING**

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Clean and polish exposed surfaces according to manufacturer's written instructions.

### **3.3 TOILET ACCESSORIES SCHEDULE**

- A. Unless otherwise indicated in this Section, toilet accessories are scheduled on Drawings.

## **END OF SECTION**

## **SECTION 10 41 16 - EMERGENCY KEY CABINET**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes high security key storage cabinet for emergency rapid entry by first responders.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Cabinet: Show cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-mounting method and relationships of box and trim to surrounding construction.
- B. Shop Drawings: Submit drawings showing exterior and interior dimensions, emergency key cabinet mounting, and hardware.

#### **1.3 QUALITY ASSURANCE**

- A. Installer Qualifications: A qualified installer, approved by manufacturer to install and maintain manufacturer's products.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Warranty: Sample of special warranty.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For Emergency Key Cabinet to include in maintenance manuals.

#### **1.6 COORDINATION**

- A. Coordinate size of Emergency Key cabinet to ensure that type and capacity of emergency rapid entry access systems indicated are accommodated.



## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace emergency rapid entry access systems that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: One year from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Provide emergency rapid entry access system approved, listed, and labeled by FM Global.

### 2.2 EMERGENCY KEY CABINET

- A. General: Provide emergency rapid entry access system cabinets of suitable size for housing emergency rapid entry access systems of types and capacities specified.
  - 1. Basis-of-Design Product: Knox3200 Series, Knox Company. (District Standard).
- B. Emergency Key Cabinet: Recessed mount, plate steel housing, steel door with interior gasket seal and stainless steel hinge, and tamper-resistant fasteners.
  - 1. Finish: Manufacturer's standard powder coat finish, color as selected by Architect..
  - 2. Capacity: 10 keys or 3 access cards.
  - 3. Aluminization for rust and corrosion protection.
  - 4. Coordinate order placement with Fire Department authorization. Coordinate mounting height and location in field with Owner and Architect.

### 2.3 FABRICATION

- A. Weld joints and grind smooth.
- B. Provide factory-drilled mounting holes.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine emergency rapid entry access system for acceptable site conditions for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. General: Install cabinet in location indicated on Drawings and in compliance with requirements of authorities having jurisdiction.
- B. Emergency Key Cabinet: Fasten cabinet to be installed square and plumb in accordance with Manufacturer's installation instructions.

### **3.3 ADJUSTING AND CLEANING**

- A. Remove temporary protective coverings and strippable films, if any, as Emergency Key cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust Emergency Key cabinet door to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of Emergency Key cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Replace Emergency Key cabinet that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION**

## **SECTION 10 44 00 - FIRE-PROTECTION SPECIALTIES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes fire extinguishers and fire extinguisher cabinets.

#### **1.2 COORDINATION**

- A. Coordinate size of fire-extinguisher cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: Submit product data including construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.
  - 1. Fire Extinguishers: Include rating and classification.
  - 2. Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, panel style.
- B. CALgreen Submittals:
  - 1. Product Data for Section 5.508.1: Provided documentation showing that proposed HVAC, refrigeration and fire suppression equipment contains no Chlorofluorocarbons (CFCs) or Halons, as required in CALgreen Section 5.508.1.1 and Section 5.508.1.2.

#### **1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."
- C. Listing: Fire extinguishers shall be UL listed with UL Listing Mark for type, rating, and classification of extinguisher.

## 1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of portable fire extinguishers that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Failure of hydrostatic test according to NFPA 10.
    - b. Faulty operation of valves or release levers.
  2. Warranty Period: Six years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 FIRE EXTINGUISHERS

- A. General: Provide fire extinguishers for each fire extinguisher cabinet and at other locations indicated.
1. Mounting Brackets: Manufacturer's standard steel, designed to secure extinguisher indicated and with plated or baked-enamel finish.
    - a. Provide brackets for extinguishers located and not located in cabinets.
- B. Multipurpose Dry-Chemical Type: UL-rated 4-A:60-B:C, 10-lb. nominal capacity, in enameled-steel container.
- C. Located on Drawings by Designation: FE.
- D. HVAC, refrigeration, and fire suppression equipment and systems, shall contain no CFCs or halons.

### 2.2 FIRE-EXTINGUISHER CABINETS

- A. General: Provide fire extinguisher cabinets of suitable size for housing fire extinguishers of types and capacities specified.
- B. 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.
1. Fire-Rated Cabinets: Listed and labeled to meet requirements in ASTM E 814 for fire-resistance rating of wall where it is installed.

- a. Construct fire-rated cabinets with double walls fabricated from 0.0478 inch thick, cold-rolled steel sheet lined with minimum 5/8 inch thick, fire-barrier material.
  2. Cabinet Material: Enameled-steel sheet.
  3. Cabinet Mounting: Recessed unless otherwise indicated.
  4. Cabinet Trim Style: Trimless with hidden flange of same metal and finish as box that overlaps surrounding wall finish and that is concealed from view by an overlapping door.
  5. Cabinet Trim Material: Manufacturer's standard steel sheet.
  6. Door Material: Manufacturer's standard steel sheet.
  7. Door Glazing: Manufacturer's standard, as follows:
    - a. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, Class 1 (clear).
  8. Door Style: Manufacturer's standard design vertical duo panel with frame with 1/4 inch thick glass.
  9. Door Construction: Fabricate doors according to manufacturer's standards, of materials indicated, and coordinated with cabinet types and trim styles selected.
  10. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide exposed door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.
- C. Accessories:
1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
  2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
    - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
      - 1) Location: Applied to cabinet door.
      - 2) Application Process: Pressure-sensitive vinyl letters.
      - 3) Lettering Color: Red.
      - 4) Orientation: Vertical.
- D. Products and Manufacturers: One of the following:
1. Larsens Manufacturing Company; Occult Series Fire Extinguisher Cabinets.
  2. Potter Roemer; Dana Series Fire Extinguisher Cabinets.
  3. JL Industries, Inc.; Embassy Series Fire Extinguisher Cabinets.
- E. Located on Drawings by designation: FEC.

### **2.3 FINISHES**

- A. General: Apply finishes in factory after products are assembled. Protect cabinets with plastic or paper covering, prior to shipment.
- B. Painted Finishes: Provide painted finish to comply with requirements indicated below for extent, preparation and type:
  - 1. Color: Provide color or color matches indicated, or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors.
  - 2. Preparation: Clean surfaces of dirt, grease, and loose rust or mill scale.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

### **3.2 INSTALLATION**

- A. General: Follow manufacturer's printed instructions for installation.
- B. Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
  - 1. Fasten cabinets to structure, square and plumb.

### **3.3 ADJUSTING AND CLEANING**

- A. Adjust cabinet doors to operate freely without binding. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged units.
- B. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

## **END OF SECTION**

## **SECTION 11 52 13 - PROJECTION SCREENS**

### **PART 1 - GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Automatic, electrically operated, roll-up projection screens, controls, and accessories.

#### **1.02 RELATED SECTIONS**

- A. Section 05 50 00 - Metal Fabrications.
- B. Section 26 00 10 – Electrical Work.
- C. Section 09 22 16 - Non-structural metal framing
- D. Section 09 51 13 - Acoustical Ceilings
- E. Section 08 31 00 - Access Doors and Panels

#### **1.03 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Manufacturer's installation, operation, maintenance, and cleaning instructions.
- C. Shop Drawings: Indicate dimensions, fabrication and installation details, and electric wiring diagrams. Indicate all dimension of screen in elevation.
- D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

#### **1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Firm with 10 years minimum successful experience manufacturing electric projection screens.
- B. Installer Qualifications: Authorized and trained by the manufacturer to install systems required.

- C. Definition of Terms for Specifications:
1. Fresnel lens: Lens composed of many small lenses arranged to produce a short focal length.
  2. Gain: Indication of screen's luminance or brightness measured perpendicular of screen center and measured relative to a block of magnesium carbonate which serves as the standard for 1.0 gain. Higher numbers indicate greater brightness. Gain shall be determined in accordance with SMPTE RP 94-2000.
  3. Keystone: Distortion of projected image when screen is not perpendicular with center line of projected image.
  4. Lenticulated: Surface onto which a pattern of small convex lenses have been impressed.
  5. Viewing angle: Angle from perpendicular center of screen at which the gain or brightness is decreased by 50 percent

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction

#### **1.06 PROJECT CONDITIONS**

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Acceptable Manufacturers:
  1. Draper, Inc.
  2. Or equal

#### **2.02 PROJECTION SCREENS**

- A. Basis of Design
  1. Items specified are to establish a standard of quality for design, function, materials, and appearance.
- B. Type A – Ceiling Mounted Electric Projection Screens – Draper Targa.:
  1. Viewing Surface: Matt White XT1000E
  2. Viewing format: See attached screen schedule.



3. UL Label: Recessed installed in return air ceiling plenums shall be certified by Underwriters Laboratory (UL), Inc. and shall bear UL label.
  4. Size: See attached screen schedule.
  5. Masking: Black masking borders.
  6. Each side of the fabric to have tab guide cable system to maintain even lateral
  7. tension and hold surface flat
  8. Extra Drop Masking: See attached screen schedule
  9. Finish: Coordinate finish with Architect.
  10. Low voltage control: Single Motor Low Voltage Control (LCV) – built-in.
  11. RS232 Serial Control
  12. Wall switch: Low voltage, wall mounted, three position switch.
  13. Limit switches: Pre-set, adjustable switches to automatically stop viewing surface, and case closure door where scheduled, in up or down positions.
  14. Silent motor with LVC: Silent Motor with Integrated LVC for sizes up to 9 by 12 feet.
- C. Type B – Wall Mounted Electric Projection Screens – Draper Premier:
1. Viewing Surface: Matt White XT1000E
  2. Viewing format: See attached screen schedule.
  3. UL Label: Recessed installed in return air ceiling plenums shall be certified by Underwriters Laboratory (UL), Inc. and shall bear UL label.
  4. Size: See attached screen schedule.
  5. Masking: Black masking borders.
  6. Each side of the fabric to have tab guide cable system to maintain even lateral
  7. tension and hold surface flat
  8. Extra Drop Masking: See attached screen schedule
  9. Finish: Coordinate finish with Architect.
  10. Low voltage control: Single Motor Low Voltage Control (LCV) – built-in.
  11. RS232 Serial Control
  12. Wall switch: Low voltage, wall mounted, three position switch.
  13. Limit switches: Pre-set, adjustable switches to automatically stop viewing surface, and case closure door where scheduled, in up or down positions.
  14. Silent motor with LVC: Silent Motor with Integrated LVC for sizes up to 9 by 12 feet.

## **2.03 VIEWING SURFACES CONSTRUCTION AND PERFORMANCE**

- A. Viewing Surfaces: Screen A
1. Matt White: Flame retardant, mildew resistant, white, vinyl coated fiberglass screen that can be rolled and cleaned with mild soap and water solution.
  2. Gain: 1.0.
  3. Viewing angle: 60 degrees.
  4. Masking: Black.
  5. Drop: Refer to drawings for floor to ceiling height.
  6. Drop Color: Black.
  7. Seams: To the extent possible screen surfaces shall be seamless. Where required by size, provide a minimum number of flat, horizontal seams.
  8. Vertical seams are not acceptable.

### **PART 3 - EXECUTION**

#### **3.01 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.

#### **3.02 PREPARATION**

- A. Coordinate provision of screens with locations of other wall and ceiling mounted components such as visual display boards, casework, structural framing, light fixtures, air diffusers, ducts, and fire sprinklers to eliminate potential conflicts.
- B. Coordinate requirements for blocking, construction of recesses, and auxiliary structural supports to ensure adequate means for installation of screens.
- C. Coordinate requirements for power supply, conduit, and wiring required for electric screen and controls.

#### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Installation hardware: Provide attachment hardware, fasteners, and other components of type, size, and spacing recommended by manufacturer for complete, functional, secure installation of screens.

#### **3.04 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion

TABLE 1. AV PROJECTION SCREEN SCHEDULE

PROJECTION SCREEN SCHEDULE							
Room Numbers	Room Name	Screen Type	Viewable Image Size (Inches)	Distance from Bottom of Image to Finished Floor (Inches)		Total Black-drop (Inches)	Qty Per room
MM122	Architecture 1	A	116 x 72.5	48		24	1
MM121	Anthropology	A	116 x 72.5	48		24	1
MM124	Studio	A	116 x 72.5	48		24	1
MM120	Plant Science	A	116 x 72.5	48		24	1
MM119	Horticulture	A	116 x 72.5	48		24	1
MM102, MM103	General Classroom	A	116 x 72.5	48		24	1
MM101	Meeting	B	116 x 72.5	60		24	1

**END OF SECTION 11 52 13**

## SECTION 12 24 13 - ROLLER WINDOW SHADES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Manually operated roller shades with single or double rollers as indicated.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.

B. CALgreen Submittals:

1. Product Data for Section 5.504.4.1.1: For sealants, adhesives and caulks, provide documentation including printed statement of VOC content showing compliance with SCAQMD Rule 1168 VOC limits and CCR (California Code of Regulations) Title 17 for aerosols.
2. Product Data for Section 5.504.4.1.2: Provide documentation for aerosol adhesives, and smaller unit sizes of adhesives, sealant, and caulking compounds (in units of product, less packaging, which do not weigh more than one (1) pound and do not consist of more than sixteen (16) fluid ounces) comply with statewide VOC standards and prohibitions on use of certain toxic compounds, of CCR Title 17, commencing with Section 94507.

C. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other Work, operational clearances, and relationship to adjoining work.

D. Samples for Verification:

1. Complete, full-size operating unit not less than 16 inches wide for each type of roller shade indicated.
2. For the following products:
  - a. Shade Material: Not less than 12-inch- square section of fabric, from dye lot used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of material.

E. Window Treatment Schedule: Include roller shades in schedule using same room designations indicated on Drawings.

### **1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.

### **1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:
  - 1. Methods for maintaining roller shades and finishes.
  - 2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
  - 3. Operating hardware.

### **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. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

### **1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: An experienced installer who has completed installation of roller shades 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. Source Limitations: Obtain roller shades through one source from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. Flame-Resistance Ratings: Passes NFPA 701.

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

- A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in a window treatment schedule.

## 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, 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 roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional regulations as shown in CALgreen Section 5.504.4.1.
- B. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds shall comply with regulations as shown in CALgreen Section 5.504.4.2.

### 2.2 MANUFACTURERS

- A. Basis of Design Product: Subject to compliance with requirements, provide products scheduled on Drawings, or a comparable product by one of the following:
  - 1. Draper.
  - 2. Lutron.
  - 3. Nysan Shading Systems Ltd.
  - 4. Sol-R-Shade, DFB, Inc.

### 2.3 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

- 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 .
    - a. Loop Length: Full length of roller shade.
    - b. Limit Stops: Provide upper and lower ball stops.
    - c. Chain-Retainer Type: Chain tensioner, sill mounted.

- B. Rollers: 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: Right side of interior face of shade.
  - 2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
- C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- D. Shadebands:
  - 1. Shadeband Material: Light-filtering fabric.
  - 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
    - a. Type: Enclosed in sealed pocket of shadeband material.

#### **2.4 MANUALLY OPERATED SHADES WITH DOUBLE ROLLERS (ALTERNATE)**

- 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 .
    - a. Loop Length: Full length of roller shade.
    - b. Limit Stops: Provide upper and lower ball stops.
    - c. Chain-Retainer Type: Chain tensioner, sill mounted.
- B. Rollers: 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: Side by side.
  - 2. Inside Roller:
    - a. Drive-End Location: Right side of interior face of shade.
    - b. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
  - 3. Outside Roller:
    - a. Drive-End Location: Right side of interior face of shade.
    - b. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.

- C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- D. Inside Shadebands:
  - 1. Shadeband Material: Light-filtering fabric.
  - 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.
- E. Outside Shadebands:
  - 1. Shadeband Material: Light-blocking fabric.
  - 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
    - a. Type: Exposed with endcaps and integral light seal at bottom where it meets the sill.
    - b. Color and Finish: As selected by Architect from manufacturer's full range.

## 2.5 INSTALLATION ACCESSORIES

- A. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
  - 1. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than height indicated on Drawings.
  - 2. Provide pocket with lip at lower edge to support acoustical ceiling panel.
- B. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
  - 1. Closure-Panel Width: As indicated on Drawings.
- C. Installation Accessories Color and Finish: As selected from manufacturer's full range.

## 2.6 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. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
  - 1. Source: Roller shade manufacturer.



2. Type: As scheduled on Drawings.
3. Roll Width: As scheduled on Drawings.
4. Orientation on Shadeband: As indicated on Drawings.
5. Color: As indicated on Drawings.

C. Light-Blocking Fabric (Alternate): Opaque fabric, stain and fade resistant.

1. Source: Roller shade manufacturer.
2. Type: As scheduled on Drawings.
3. Roll Width: As scheduled on Drawings.
4. Orientation on Shadeband: Up the bolt .
5. Color: As indicated on Drawings.

## 2.7 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 :

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.
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. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.

### 3.2 ROLLER SHADE INSTALLATION

A. 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 inches to interior face of glass. Allow clearances for window operation hardware.

- B. Roller Shade Locations: As indicated on Drawings.

### **3.3 ADJUSTING**

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

### **3.4 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.

### **3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain roller window shades. Refer to Section 01 77 00 "Closeout Procedures."

### **END OF SECTION**

## **SECTION 12 36 16 - METAL COUNTERTOPS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Stainless-steel countertops.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For metal fabrications.
  - 1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
  - 2. For countertops, show locations and sizes of cutouts and holes for items installed in metal countertops.
  - 3. For wall-mounted shelves, indicate requirements for blocking or reinforcements in supporting construction.

#### **1.3 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products only after casework and supports on which they will be installed has been completed in installation areas.
- B. Keep finished surfaces of products covered with polyethylene film or other protective covering during handling and installation.

#### **1.4 FIELD CONDITIONS**

- A. Field Measurements: Where products are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

## **PART 2 - PRODUCTS**

### **2.1 STAINLESS-STEEL FABRICATIONS**

- A. Countertops: Fabricate from 0.062-inch- thick, stainless-steel sheet. Provide smooth, clean exposed tops and edges in uniform plane, free of defects. Provide front and end overhang of 1 inch over the base cabinets.
1. Joints: Fabricate countertops without field-made joints.
  2. Weld shop-made joints.
  3. Sound deaden the undersurface with heavy-build mastic coating.
  4. Extend the top down to provide a 1-inch- thick edge with a 1/2-inch return flange.
  5. Form the backsplash coved to and integral with top surface, with a 1/2-inch- thick top edge and 1/2-inch return flange.

### **2.2 MATERIALS**

- A. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 316L.
- B. Sealant for Countertops: Manufacturer's standard sealant that complies with applicable requirements in Section 07 92 00 "Joint Sealants" and the following:
1. Mildew-Resistant Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, silicone.
  2. Color: As selected by Architect from manufacturer's full range.
  3. Sealant shall have a VOC content of 250 g/L or less.
  4. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

### **2.3 STAINLESS-STEEL FINISH**

- A. Grind and polish surfaces to produce uniform, directional satin finish matching No. 4 finish, with no evidence of welds and free of cross scratches. Run grain with long dimension of each piece. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces clean.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install metal countertops level, plumb, and true; shim as required, using concealed shims.
- B. Field Jointing: Where possible, make field jointing in the same manner as shop jointing; use 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.
- C. Secure countertops to cabinets with Z- or L-type fasteners or equivalent; use two or more fasteners at each front, end, and back.
- D. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
- E. Seal junctures of countertops, splashes, and walls with sealant for countertops.

### **3.3 CLEANING AND PROTECTION**

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces. Remove and replace damaged products or touch up and refinish damaged areas to match original factory finish, as approved by Architect.
- C. Protection: Provide 6-mil plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

## **END OF SECTION**

## **SECTION 12 93 00 - SITE FURNISHINGS**

### **PART 1 - GENERAL**

#### **1.1 WORK INCLUDED**

- A. Benches
- B. Tables & Chairs
- C. Trash & Recycling Receptacles
- D. Plant Containers
- E. Bicycle Racks

#### **1.2 RELATED WORK**

- A. Section 32 93 00 – Plants

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Wood: IPE
- B. Galvanized Steel: ASTM A53 or A120 pipe; ASTM A123 or A153 zinc coating on fabricated steel parts after fabrication (hot-dip galvanized).
- C. Concrete or Non-Shrink Grout: As recommended by site furnishings manufacturer or vendor.

## **2.2 RECYCLED CONTENT**

- A. Recycled Material Content: Minimum 90%.

## **2.3 FABRICATION**

- A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.
- B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.
- C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend with buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- D. Exposed Surfaces: Polished, sanded, or other finished; surfaces smooth, free of burrs, barbs, splinters, and sharpness; edges and ends rolled, rounded, or capped.
- E. Factory Assembly: Assemble components in the factory to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

## **2.4 STEEL AND GALVANIZED-STEEL FINISHES**

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

## **2.5 IRON FINISHES**

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

## **2.6 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 directional finishes with long dimension of each piece.
  - 2. Directional Satin Finish: No. 4.
  - 3. Dull Satin Finish: No. 6.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- B. Dimensions upon which Work of this Section may be contingent are to be verified at the project site to ensure proper placement and fit of equipment in the allotted areas.
- C. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- D. Set site furnishings plumb, level, and true to line with a neat and finished appearance. Include setting each item in its correct place, fastening it, connecting it, or incorporating it into other portions of the Work, as each item may require; testing and operating equipment to assure proper function.
- E. Include the providing of anchors and adhesives required for installing and attaching the items specified, in accordance with manufacturer's printed specifications.
- F. Keep the premises free from accumulation of waste materials and rubbish caused by this Work. Remove waste materials as specified in other Sections of these specifications.

**END OF SECTION 12 93 00**



## **SECTION 13 4823 - SOUND AND VIBRATION CONTROL ASSEMBLIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED WORK**

- A. Requirements: Provide sound and vibration isolated floors, walls and ceilings in accordance with Contract Documents.
- B. Related Sections.
  - 1. Section 09 2116 – Gypsum Board Assemblies.
  - 2. Section 09 2213 – Metal Furring Channels.
  - 3. Section 09 2216 – Non-Structural Metal Framing

#### **1.2 SUBMITTALS**

- A. General: Submit the following in accordance with Section 013000 – Submittals.
- B. Product Data: Each type of isolation material.
- C. Shop Drawings: Lay out drawings indicating floating concrete floor reinforcement, and vibration isolator and sway brace mount locations.
- D. Vibration Isolator hanger and resilient clip load and deflection curves.

#### **1.3 QUALITY ASSURANCE**

- A. Set isolation hangers and resilient clips under manufacturer's supervision.
- B. Pre-Installation Conference: Prior to commencement of sound and vibration isolation work, schedule meeting at mutually agreeable time to include Owner, Architect, Contractor, Contractor's field superintendent, sound and vibration isolation installer, materials manufacturer's representative, and other interested parties to review methods and procedures to be used to achieve end result.

#### **1.4 DELIVERY AND STORAGE**

- A. Delivery: Deliver in manufacturer's unopened containers fully identified with manufacturer's name, trade name, type, class, grade, and size.
- B. Storage: Store in unopened containers, off ground and protected from damage.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Resilient Isolation Clips: Resilient clips shall consist of neoprene isolating element (maximum 50 durometer) surrounded by steel brackets. The brackets shall be of sufficient strength to carry the wall or ceiling weight without bending or failure. The resilient clips shall be equipped to secure standard 7/8-inch x 25 gauge galvanized steel furring channels that will support two layers of gypsum board. The resilient clips shall resiliently isolate the gypsum board from direct structural connection to the building structure. Vertical Load capacity. Clips shall have sufficient capacity to support wall or ceiling weights as constructed. In a vertical load test comparable to a ceiling installation, the clip shall have a minimum design load capacity of 36 lbs. using 25 gauge furring channel. The minimum design load capacity when using 22 gauge furring channel shall be 48 lbs. Design Load capacity shall be based on a safety factor where the load to failure, defined as pullout of the channel from the clip, is a minimum 2.5 times the allowable maximum Design Load. Anchors for attachment of the clips to the substructure shall be selected to support wall and/or ceiling weights at each clip.
1. Kinetic Noise Control IsoMax resilient isolation clips.
  2. Pliteq GeniClip resilient isolation clips.
  3. PAC International Type RSIC resilient isolation clips.
  4. or approved equal.
- B. Unfaced Mineral/Glass Fiber Blanket/Batt Acoustical Insulation: Three-inch thick (minimum) unfaced semi-rigid mineral fiber or glass fiber blankets. Acoustical insulation to comply with ASTM C665, Type I, with maximum flame spread of 25 and smoke development of 50 per ASTM E 84.
1. Johns Manville Unfaced Fiber Glass Insulation
  2. Owens Corning Sound Attenuation Batt Insulation
  3. Certainteed NoiseReducer Insulation
  4. or approved equal.
- C. Acoustical Sealant: Non-drying, non-hardening, non-skinning, non-staining, gunnable, synthetic rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound.
1. USG Sheetrock Brand Acoustical Sealant.
  2. Tremco Acoustical Sealant.
  3. Pecora Corp AIS-919 Acoustical Sealant.

4. or approved equal.
- D. Moldable Sheet Caulk or Firestop Putty Pads for Outlet Boxes and AV Back Boxes: Putty pads should consist of a non-hardening, intumescent compound 1/8-inch thick minimum sheet caulk designed to seal the back and sides of electrical outlet boxes.
1. Harry A Lowry Outlet Box Pads.
  2. 3M Fire Barrier Moldable Putty Pads MPP+.
  3. Kinetics Noise Control IsoBacker Putty pads
  4. or approved equal.

### **PART 3 - EXECUTION**

#### **3.1 INSPECTION**

- A. Examination: Examine substrates, adjoining construction and condition under which Work is to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected.

#### **3.2 OUTLET AND AV BACK BOX PADS (WALL AND SOUND CONTROL CEILINGS)**

- A. Ensure that the surface of the electrical outlet box and AV back box is clean of dirt, rust, oil, release agents, repellants and any other substances that may affect proper adhesion.
- B. All wiring shall be completed prior to the installation of the moldable putty pads.
- C. Wrap the back and sides of the electrical outlet boxes and AV back boxes located within acoustic walls and ceilings with 1/8-inch moldable putty pads. The pads shall provide an airtight seal around the perimeter of the boxes.
- D. Caulk the joint between the electrical outlet box/AV back box and adjacent gypsum board with acoustical sealant.

#### **3.3 RESILIENT CLIP WALL INSTALLATION**

- A. Install resilient sound isolation clips and drywall furring channels in accordance with manufacturer's instructions.
- B. Mechanically fasten resilient sound isolation clips to structure with structurally appropriate screws, bolts, or expansion anchors, dependent upon structure.
- C. Fire-Resistive Design Assemblies:
1. Install as specified in UL Fire Resistance Directory, where required.

2. Do not arbitrarily add resilient sound isolation clips to fire-rated assemblies.
- D. Space resilient sound isolation clips at maximum of 24 inches by 48 inches on center for walls and ceilings:
1. Spacing between furring channels shall be a maximum of 24 inches.
  2. Spacing of clips on the furring channel shall be a maximum of 48 inches.
- E. Ensure metal ferrule of resilient sound isolation clips is in firm contact with structural member.
- F. Install drywall furring channels per manufacturer's installation instructions.
1. Space Drywall Furring Channels to comply with manufacturer's published maximum load capacity of each clip both in shear (wall application) and in tension (ceiling application).  
Note: the maximum load capacity depends on the clip and on the gauge of the furring channel used.
  2. Reduce spacing of drywall furring channels to prevent potential for sagging of gypsum board or when additional loads are supported by resilient sound isolation clips.
  3. Stagger isolation clip installation, so dead load is supported by all support members.
  4. Do not exceed design load (pull and shear) of 36 pounds per isolation clip.
- G. The bottom row of clips with furring channel(s) should be a maximum 3 inches to the center of the channel from the floor. The top row should be within 6 inches of the ceiling.
- H. Locate resilient sound isolation clips maximum of 8 inches from ends of drywall furring channels.
- I. Splicing Drywall Furring Channels:
1. Splice drywall furring channels with minimum of 6-inch laps.
  2. Secure laps with 2 framing screws or 18 gauge tie wire double wrapped.
  3. Locate splices between resilient sound isolation clips.
  4. Do not locate splices on resilient sound isolation clips.
- J. Flanking Noise:
1. Review installation details to prevent structure-borne flanking noise.
  2. Do not allow drywall furring channels or gypsum board to contact foreign materials, including floors, ceilings, or wall framing members.
- K. Gypsum Board:
1. Install gypsum board in vertical or horizontal position with 1/8-inch to 1/4-inch maximum gap around perimeter for acoustical sealant application. The gypsum board should not come into rigid contact with the ceilings or other horizontal elements.
  2. The first layer of gypsum wallboard shall align seams between sheets on the centerline of the horizontal furring channels.
  3. The first row of gypsum wallboard sheets at the bottom of the wall shall be installed with the long dimension supported on a 1/4 inch thick continuous resilient isolation strip, Kinetics Model RWS

4. Install gypsum board in accordance with ASTM C 840 as specified in Section 09250.
- L. Acoustical Sealant:
1. Seal all joints, gaps, penetrations, etc with acoustical sealant to achieve airtight construction.
  2. Seal electrical outlets and penetrations with acoustical sealant.
  3. Apply fire-rated acoustical sealant at locations where fire-rated assembly is required.
- M. Putty Pad Sealant: Acoustically seal with putty pads, electrical boxes in walls and ceilings in which resilient sound isolation clips are used. The putty pad should completely enclose the back and sides of the electrical boxes.

**END OF SECTION 13 48 23**

**Waveguide LLC**  
005.2882.000

January 10, 2022  
DSA Back Check

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

## SECTION 21 05 17 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION 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 water stop 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, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
1. Advance Products & Systems, Inc.
  2. CALPICO, Inc.

3. Metraflex Company (The).
- C. 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: Stainless 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: Non-shrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 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 079200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Comply with requirements for fire stopping specified in Section for "Penetration Fire stopping."

### **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: Cast-iron wall sleeves.
    - b. Piping NPS 6 and Larger: Cast-iron 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 (25-mm) 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 systemized-steel-pipe 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-on-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.
  
- 4. Concrete Slabs above Grade:
  - a. Piping Smaller Than NPS 6: PVC-pipe sleeves.
  - b. Piping NPS 6 and Larger: PVC-pipe sleeves.
  
- 5. Interior Partitions:
  - a. Piping Smaller Than NPS 6: PVC-pipe sleeves.
  - b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

**END OF SECTION 21 05 17**

## **SECTION 21 05 18 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Escutcheons.
  - 2. Floor plates.

#### **1.2 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.

#### **2.2 FLOOR PLATES**

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

### **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 Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
  - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
  - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
  - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
  - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
  - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
  - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.
- 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.

### **3.2 FIELD QUALITY CONTROL**

- A. Replace broken and damaged escutcheons and floor plates using new materials.

**END OF SECTION 21 05 18**

## **SECTION 21 05 53 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
1. Equipment labels.
  2. Warning signs and labels.
  3. Pipe labels.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.

### **PART 2 - PRODUCTS**

#### **2.1 EQUIPMENT LABELS**

- A. Metal Labels for Equipment:
1. Material and Thickness: Brass, 0.032 inch thick, with predrilled 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. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- C. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and 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, 1/8 inch thick, with predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- F. Fasteners: Stainless-steel rivets or self-tapping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. 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.

## **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 LABEL INSTALLATION**

- 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 or permanently fasten labels on each major item of mechanical equipment.
- D. Locate equipment labels where accessible and visible.
- E. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting."
- F. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection excluding short takeoffs. 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 [25 feet along each run. Reduce intervals to 12 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

**END OF SECTION 21 05 53**

**P2S Inc.**  
005.2882.000

January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California



## SECTION 21 13 13 - WET PIPE SPRINKLER SYSTEM

### PART 1 - GENERAL

#### 1.1 GENERAL AND SPECIAL CONDITIONS:

- A. General and special conditions apply to the work in this section
- B. The contractor shall furnish all equipment, materials, tools, labor, engineering, drawings, etc. necessary for a complete fire protection system, with said system being made ready for the operations in accordance with the requirements of the Authority Having Jurisdiction. The purpose of the permit drawings and specifications is to convey to the contractor the scope of work required, all of which the Contractor is responsible to furnish, install, adjust, and make operable. The omission of the Owner of any necessary system component as required by the Authority Having Jurisdiction, in the specifications shall not relieve the Contractor of the responsibility for providing such necessity, without additional cost to the owner. The Contractor shall visit the site before submitting his bid and shall examine all existing physical conditions that may be material to the performance of his work. No extra payment will be allowed to the contractor as a result of extra work made necessary by his failure to do so. Any case of error, omission, discrepancy or lack of clarity shall be promptly identified to the owner, Architect, Engineer for clarification prior to the bid due date.
- C. The Contractor shall provide all devices and equipment required by these specifications. Under no circumstances will the Contractor delete any equipment or devices without the written directive of the Owner.
- D. This Section specifies materials, methods, and equipment to be used for automatic sprinkler system and related fire protection piping to 5 ft outside building.
- E. Each wet pipe zone shall begin with:
  - 1. Zone control valve with tamper switch.
  - 2. Flow switch.
  - 3. Inspectors test and drain valve.
  - 4. Pressure gauges.
- F. This Section specifies design criteria for fire protection system. Zone and main piping layouts of fire protection system have been established, as it relates to architecture, structure and mechanical/electrical systems. Fire Protection Contractor, based on these layouts, shall produce installation drawings which are also referred to as shop drawings in this Specification.

#### 1.2 SYSTEM ABBREVIATIONS AND DEFINITIONS

- A. AHJ – Authority Having Jurisdiction
- B. ANSI – American National Standard Institute

- C. Approved – Unless otherwise stated, materials, equipment or submittal approved by the Engineer.
- D. Architect – Gensler
- E. ASTM – American Society for Testing and Materials
- F. AWS – American Welding Society
- G. AWWA – American Water Works Association
- H. Concealed – Where used in connection with installation of piping or conduit and accessories, shall mean, “Hidden from sight” as in shafts, furred spaces, in soffits or above suspended ceilings.
- I. Contractor – The Company awarded the prime contract for this work and any of its subcontractors, vendors, suppliers, or fabricators.
- J. Engineer – P2S Inc.
- K. Exposed - Where used in connection with installation of piping or conduit and accessories, shall mean, “visible” or “not concealed”.
- L. FDC – Fire Department Connection
- M. FM – FM Global.
- N. FM Approved – Materials or equipment approved by Factory Mutual and included on the most recent edition of the FM Approval Guide.
- O. Furnish – Supply materials.
- P. GPM – Gallons per minute.
- Q. Install – Install materials, mount, and connection equipment assemblies.
- R. NFPA – National Fire Protection Association
- S. PIV – Post indicating valve.
- T. Provide – Furnish, install and connect.
- U. PSI – pounds per square inch.
- V. Remove – Remove material and equipment and restore surface.
- W. UL – Underwriters Laboratories, Inc.
- X. UL Listed – Materials or equipment by Underwriters Laboratories and included in the most recent edition of the UL Fire Protection equipment Directory.

### 1.3 SCOPE OF WORK:

- A. Provide complete fire protection system as outlined in the project specifications, including all labor, materials, permit, shop drawings and hydraulic calculations needed to furnish and install a complete functional automatic sprinkler system in accordance with NFPA 13, and all of the following:
1. Wet pipe automatic sprinkler system throughout the building, complete with supervised control valves, inspectors test and main drains assemblies, vane type water flow switch, and pressure gauges.
  2. The sprinkler on each floor shall have a control valve, check valve, flow and tamper switch, and inspector test and drain assembly, located within fire riser closet.
  3. Any required core drilling of floors and walls, and provide FM approved non-combustible fire stopping materials at all fire protection piping penetrations of fire resistance rated construction. Piping penetrations shall be adequately fire stopped to maintain the fire resistance rating required.
  4. Earthquake bracing and flexible coupling.
  5. Furnish, install and adjust all waterflow and valve supervisory switches.
  6. Coordinate all work with other trades. During bidding, Contractor shall review his work with other trade to identify any obstructions from beams, ducts, diffusers, lights, structures, etc. Provide cost allowance for piping adjustment, additional piping and sprinklers as required. All changes shall be reflected on shop drawings.
  7. Coordinate and interface of alarm initiating and supervisory devices with the fire alarm system.
  8. Coordinate size of sewer connection with the drain riser with plumbing contractor to ensure adequate drainage of the drain riser during testing.
  9. Fire department connections.
  10. Shop drawings.
  11. Two (2) sets of operating instructions and valve diagrams.
  12. As-built drawings. The Contractor shall provide as-built drawings in Revit and PDF format in addition to required full size reproducible drawings.
  13. Contractor shall provide hydraulic calculation if there is any deviation or propose deviation from the approved set as a result of site condition and coordination.
  14. On-site project supervision.
  15. Required signs in English at all control valves, main drains, auxiliary drains and inspectors test connections, etc., including hydraulic placards, in accordance with NFPA 13 and NFPA 14 requirements.
  16. Cabinet containing the required number and type of spare sprinklers and corresponding wrenches, to be located in riser room.
  17. All required system testing in accordance with NFPA 13, 14, 22, 24, and 25.
  18. Warranty on all materials and labor.
  19. All permits, taxes and fees, including AHJ inspection and testing fees necessary to complete the specified work.

### 1.4 RELATED WORK:

- A. Materials and methods specified in other sections, included but not limited to:
1. Cutting and patching.

2. Fire extinguishers, cabinets, and accessories.
3. Painting of finished surfaces at pipe penetrations by other than Contractor.
4. Grading.

B. Materials furnished and installed in this section but wired by others:

1. Valve supervisory devices shall be furnished and installed the Contractor but wired by the alarm contractor.
2. Water flow switches shall be furnished and installed by the Contractor but wired by the alarm contractor.

## **1.5 DESIGN CRITERIA**

A. Flow Test: See drawings.

B. This flow test data will be used as basis for Contract Documents. Sprinkler Contractor, prior to preparation of installation design calculations, shall validate this flow data.

C. Send current hydrant flow test data to Engineer.

D. Hydraulically calculated system shall be designed to a minimum of 10% below available water flow curve.

E. Systems that are hydraulically calculated must include 1.2 factor for design area.

F. Sprinkler System:

1. Office areas and general building spaces shall be hydraulically designed to provide minimum density of 0.10 gpm per sq ft over most hydraulically remote 1500 sq ft. Maximum spacing shall not exceed 225 sq ft per head.
2. Copy rooms, electrical rooms, and storage areas shall be hydraulically designed to provide minimum density of 0.15 gpm per sq ft for most remote 1500 sq ft. Maximum spacing shall not exceed 130 sq ft per head.
3. Architectural 4 and dust collection room shall be hydraulically designed to provide minimum density of 0.20 gpm per sq ft for most remote 1500 sq ft. Maximum spacing shall not exceed 130 sq ft per head.

G. Hose Streams:

1. Add 250 gpm hose stream to sprinkler zone hydraulic calculations.

H. Fire Protection System Layout and Shop Drawings:

1. Contractor shall review Design Drawings and Specifications, and shall produce Shop Drawings, calculations, and product data sheets.
2. Conceal sprinkler piping above ceilings where possible.
3. Contractor shall consult with Architect during development of piping layout to avoid conflicts with general appearance. Pipe routing is a critical issue due to attributes of this building.

4. Submit shop drawings, calculations and product data sheets for coordination review to: Architect, and other Authorities Having Jurisdiction over this Project prior to installation (see submittals).
5. Contractor shall be held to have examined "Reflected Ceiling" drawings as well as Mechanical, Electrical, Piping, Information Technology, Structural and Architectural building plans prior to system layout.
6. Contractor shall coordinate routing of piping with other trades and Architect.
7. Contractor shall participate in coordination process and shall not install piping prior to coordination with other trades.

## **1.6 QUALITY ASSURANCE:**

### **A. Codes and Standards:**

1. NFPA 13, 2016 Installation of Sprinkler Systems
2. NFPA 72, 2016 National Fire Alarm Code
3. Underwriters Laboratories (UL) Fire Protection Equipment Directory
4. California Building Code – Latest Version
5. California Fire Code – Latest Version
6. Title 19 of California Code of Regulations – Latest Version

### **B. Contractor Installation Program:**

1. Licensed persons employed by Sprinkler Contractor shall perform planning, calculations, layout, and installation. Certified sprinkler designer, National Institute for Certification of Engineering Technologies, (NICET) Level IV or licensed Professional Engineer for planning and calculations, and journeyman sprinkler fitters for installation foreman and supervisory personnel.
2. Journeyman automatic fire sprinkler fitter(s) shall supervise field installation.
3. Contractor shall be licensed in the State of California for Installation of Fire Protection Systems.
4. Contractor shall submit pre-qualification evidence of at least 3 projects of comparable size successfully completed with their Bid.
5. Distortion or misrepresentation of qualification evidence may result in Contract cessation.

### **C. Electrical Coordination:**

1. All relays, wire, conduit, pushbuttons, pilot lights, and other devices required for power side or the control of electrical equipment shall be furnished by Division 26 and Division 28 contractors, except as specifically noted elsewhere in this specification.
2. Should any change in electrical equipment size, horsepower rating or means of control be made to any motor or other electrical equipment after contracts are awarded, sprinkler contractor is to immediately notify Division 26 and Division 28 contractors of this change and pay any costs due to this change.
3. Division 26 contractors shall provide all power wiring and sprinkler contractor shall provide all control wiring and its conduit. Control wiring shall conform to Division 26 and 28 requirements for control wiring.
4. Sprinkler contractor shall provide exterior waterflow alarm and coordinate installation with Division 26 and Division 28 contractors.

5. Furnish wiring diagrams to Division 26 and Division 28 contractors for all equipment and devices furnished by the sprinkler contractor which have been indicated to be wired by the Division 26 and Division 28 contractors.

## **1.7 APPROVALS**

- A. P2S Inc. has prepared permit drawings, which have been approved by DSA. The Contractor shall use these drawings to prepare shop drawings to be used in system installation. The contractor shall submit the shop drawings to the Engineer for approval prior in system installation.

## **1.8 SUBMITTALS:**

- A. Contractor shall submit complete system packages. Partial submittals will be rejected.
- B. Shop Drawings
  1. Contractor shall review Design Drawings and Specifications and shall produce Shop Drawings, calculations and product data sheets.
  2. Conceal sprinkler piping above ceilings where possible.
  3. Contractor shall consult with Architect during development of piping layout to avoid conflicts with general appearance. Pipe routing is a critical issue due to attributes of this building.
  4. Submit three sets of complete shop drawings, and three sets of manufacturer's data to Architect, Engineer, DSA, and other Authorities Having Jurisdiction for all necessary reviews prior to fabrication and installation of materials. Three sets of hydraulic calculations shall be provided if contractor propose any deviation to the approved set.
  5. Hydraulic calculations shall include a water supply graph and hydraulic cover sheet. The cover sheet shall include the name and location of the calculated area, ceiling height, occupancy, design criteria, sprinkler spacing, system type, sprinkler make, model, size, K-factor and temperature rating, flow requirements, C-factor used, water supply data and source of information.
  6. Contractor shall be held to have examined "Reflected Ceiling" drawings as well as Mmechanical, Electrical, Piping, Information Technology, Structural and Architectural building plans prior to system layout.
  7. Contractor shall coordinate routing of piping with other trades and Architect.
  8. Contractor shall participate in coordination process and shall not install piping prior to coordination with other trades.
  9. Prepare shop drawings with a minimum scale of 1/8 inch = 1 foot-0 inch for plans, and 1/4 inch = 1 foot-0 inch for details. Show all piping, sprinklers, hangers, type of pipe, tube connections, outlets, type of roof construction, and occupancy of each area, including ceiling and roof heights as required by NFPA 13. When welding is planned, shop drawings shall indicate the sections to be shop welded and the type of welded fittings to be used. All drawings shall be prepared using Revit.
  10. Design shall be based on these specifications and the appropriate NFPA standards.
  11. Shop drawings shall include details of earthquake sway bracing, including the appropriate calculations.
  12. Shop drawings shall include details of underground thrust blocking/restraints.

C. Changes

1. Make no changes in installation from layout as shown on the bridging drawings unless change is specifically approved by the Engineer and AHJ. This does not include minor revisions for the purpose of coordination.
2. Any pipe fabricated and/or installed before all approvals are obtained at the Contractor's own expense and responsibility. Any changes made to the approved drawings other than as stated above are at the Contractor's own expense and responsibility.

D. Manufacturer's Data

1. Provide data from manufacturer on the following devices, including installation, maintenance, and testing procedures, dimensions, wiring diagrams, etc. Where any devices that are provided or furnished involve work by someone other than the Contractor, submit additional data copies directly to the Contractor. At a minimum, the following data sheets shall be provided:
  - a. Sprinklers and escutcheons.
  - b. Pipe, fittings and hangers.
  - c. Control valves.
  - d. Tamper switches.
  - e. Flow switches.
  - f. Exterior Weatherproof Waterflow Alarm.
  - g. Sprinkler Heads.
  - h. Sprinkler Head Cabinet.
  - i. Hanger Assemblies
  - j. Pressure Gauges.
  - k. Drawings.
  - l. Seismic Restraint Detailing.
  - m. Fire Department Connection (FDC)
  - n. Fire Department Valves (FDV).
  - o. Check valves.
  - p. Waterflow devices.
  - q. Valve supervisory devices.
  - r. Bell.
  - s. Fire stopping materials (including installation detail).
2. Include items listed in product section and additional items required to provide complete installation.
3. Indicate by red marking or arrow, items to be used where more than 1 item appears on manufacturer's catalog sheet.
4. Submit shop drawings and equipment submittals to Engineer and Owner's Insurance representative prior to installation or fabrication of system components.
5. Review of submittals does not relieve Contractor from coordinating installation of work with other trades, or from compliance with Codes and Standards.

E. As-Built Drawings

1. Maintain at the site an up-to-date marked set of as-built drawings, which shall be corrected and delivered to the Owner upon completion of work.

2. Upon completion, furnish the Owner with 3 sets of reproducible sepia prints, and one set in electronic Revit and PDF format of each reviewed shop drawing, revised to show "as-built" conditions.

F. Samples

1. Provide one sample of each type of sprinkler and escutcheon.

G. Final Inspection and Test

1. The Contractor shall make arrangements with the Owner, Owner's commissioning agent, Architect, Engineer for final inspection and witnessing of the final acceptance tests. The Owner, Architect, and the Engineer will witness the final inspection.
2. Perform all tests and inspections required by the referenced codes and standards, the AHJ, and the Owner.
3. When the Engineer visits the job site for final inspection and tests after being advised by the Contractor that the work is complete and ready for test, if the work has not been completed or the final acceptance tests are unsatisfactory, the Contractor shall be responsible for the Engineer's extra time and expenses for reinspection and witnessing the retesting of the work. Such extra fees shall be deducted from payments by the Owner to the Contractor.
4. Upon completion of final inspections and tests, as required by appropriate NFPA Standards, submit copies of Standard Contractor's Material and Test Certificate.

H. Operating Instruction

1. At the completion of the work, provide a small-scale plan of building indicating the locations of all control valves, low point drains, and inspector's test valves. The plans shall be neatly drawn and color-coded to indicate the portion of the building protected by each system, framed under glass and permanently mounted on the wall at the pump room.
2. Furnish one copy of NFPA 25 and bound set of printed operating and maintenance instructions to the Owner, and adequately instruct the Owner's maintenance personnel in proper operation and test procedures of all fire protection components provided, furnished, or installed.

**1.9 SPARE PARTS**

- A. Provide and install one spare sprinkler cabinet, complete with 12 sprinklers of all types and temperature ratings used throughout the installation. The cabinet shall be equipped with sprinklers and special sprinkler wrenches required for each type of sprinkler installed.
- B. Confer with the Owner's representative for exact location of cabinet.

**1.10 GUARANTEE**

- A. The Contractor shall guarantee all materials and workmanship for a period of one year beginning with the date of final acceptance by the Owner. The Contractor shall be responsible during the



design, installation, testing and guarantee periods for any damage caused by his (or his subcontractors') work, materials, or equipment.

### **1.11 PRODUCT DELIVERY**

- A. Delivery of Materials: Delivery of all materials and equipment to the job site shall be scheduled to assure compliance with the predetermined construction schedules.
- B. Storage of Materials, Equipment and Fixtures: Contractor shall be responsible for storage of materials on job site, including furnishing of any storage facilities or structures required.
- C. Handling Materials and Equipment: Contractor shall be responsible for on-site handling of materials and equipment.

### **1.12 QUALITY ASSURANCE**

- A. Testing Agency: All materials shall be UL listed or FM approved for their intended use.
- B. Regulatory Agencies: State and local building codes and ordinances, and fire department requirements shall apply.
- C. The Contractor shall be fully experienced and licensed in all aspects of the fire protections systems herein specified.
- D. Similar materials shall be from a single manufacturer.

### **1.13 JOB CONDITIONS**

- A. Damage: Protect all unfinished work to prevent damage and furnish protection of all surrounding areas where necessary.
- B. Leak Damage: The Contractor shall be responsible during the installation and testing periods of the sprinkler system for any damage to the work of others, to the building or its contents caused by leaks in any equipment, by unplugged or disconnected pipes or fittings, or by overflow, and shall pay for the necessary replacements or repairs to work of others damaged by such leakage.

### **1.14 EMERGENCY SERVICE**

- A. The Contractor shall provide emergency repair service for the sprinkler system within four hours of a request for such service by the Owner during the warranty period. This service shall be available on a 24-hour per day, seven-day per week basis.

### **1.15 TRAINING**

- A. The Contractor shall conduct two training sessions of four hours each to familiarize the facility personnel with the features, operation and maintenance of the sprinkler systems. Training

sessions shall be scheduled by the Owner at a mutually agreeable time to the Contractor and the Owner.

### **1.16 PERMITS AND FEES**

- A. Pay for all permits, fees and charges required for this work.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. All components shall be used in accordance with the manufacturer's recommendations and its UL listing and/or FM approval.
- B. The naming of manufacturers in the specifications shall not be construed as eliminating the materials, products or services of other manufacturers and suppliers providing approved equivalent items.
- C. The substitutions of materials or products other than those named in the specifications are subject to proper approval of the Owner granted in writing.

### **2.2 MATERIALS**

- A. Materials and Equipment
  - 1. Materials and equipment in system shall be new and current products of manufacturer regularly engaged in production of such materials and equipment.
  - 2. Where 2 or more pieces of equipment are required to perform interrelated functions, they shall be products of 1 manufacturer.
  - 3. Clean and cap pipe after fabrication and prior to placing pipe in building.
  - 4. Mark pipe with tags that can be removed during installation, so no permanent markings remain on unpainted pipe located in exposed areas.
  - 5. Couplings shall be tees with capped outlets.
- B. Approval Guides:
  - 1. Unless otherwise shown, products shall be UL Listed in the latest publication of the UL Fire Protection Equipment Directory or Approved in the latest Factory Mutual Approval Guide for service intended.

### **2.3 PIPE**

- A. Above Ground:
  - 1. Feed Mains and Branch Piping

- a. Carbon steel pipe, Schedule 10, ASTM A795, ASTM A53 or A135, roll-grooved for mechanical fittings.
- b. Carbon steel pipe, Schedule 40, ASTM A795, ASTM A53 or A135, cut-grooved for mechanical fittings.
- c. In areas such as tight ceiling spaces or where exact center-of-tile placement is critical, only FlexHead sprinkler pipe is permitted. Models 2024, 2036, 2048, 2060, 2072 as manufactured by FlexHead Industries, Acton Massachusetts. Each FlexHead ceiling sprinkler system shall include multi-port ceiling mounting bracket and a 1-piece tested FlexHead sprinkler drop including adjustable flange and hardware. No other flexible sprinkler pipe is allowed for this project unless it is both UL Listed and FM Global Approved. Alternates to FlexHead flexible sprinkler pipe must also be acceptable to Owner.
- d. Provide metal pipe's exposed threads with corrosion inhibitive paint.
- e. Pipe shall be new, rated for 175 psi working pressure, conforming to ASTM specifications, and have the manufacturer's name and brand along with the applicable ASTM standard marked on each length of pipe.
  - 1) Pipe used shall be black steel and must comply with the specifications of the American Society for Testing and Materials, ASTM A53 for welded and seamless steel pipe.
  - 2) Schedule 40 piping is required for sizes 2 inches and less. Pipe ends shall be threaded or roll grooved in accordance with NFPA 13.
  - 3) Schedule 10 piping shall be provided for sizes 2½ inches and larger. Pipe ends shall be welded or roll grooved in accordance with NFPA 13.
  - 4) Hot-dipped galvanized pipe shall be used when exposed to the outside.
  - 5) Hot-dipped galvanized pipe shall be used for drain pipe.

B. Under Ground:

1. PVC PIPE AND FITTINGS

- a. PVC Pipe: AWWA C900 and Class 200, with bell end with gasket, and with spigot end.
- b. PVC Fittings: AWWA C900 and Class 200, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.

2. Building Riser

- a. Stainless Steel Type 304 In-Building Riser: NFPA 24 Section 8-3.2
  - 1) Fittings: AWWA C900 Inlet/DIP  
AWWA C606 Outlet

## 2.4 FITTINGS AND JOINTS

A. Above Ground:

1. Cast iron threaded, Class 125, 175 psi WOG pressure rating, ANSI B16.4.
2. Cast iron flanged, Class 125, 175 psi WOG pressure rating, ANSI B16.1.
3. Grooved:
  - a. Ductile iron or malleable iron, grooved for mechanical coupling, 175 psi WOG pressure rating, malleable iron conforming to ASTM A536 for ductile iron and ASTM A47 for malleable iron.
  - b. Fitting, gasket and coupling shall be furnished by same manufacturer.
  - c. Acceptable manufacturers: Victaulic, Gruvlok or Viking Corp.
  - d. Grooved fittings and couplings shall be produced by the same manufacturer.
  - e. Grooved couplings shall be dimensionally compatible with pipe.
4. Screwed fittings shall be cast iron, 175 pound class, black, and in accordance with ANSI B 16.4 or malleable iron, 175 pound class, black and in accordance with ANSI B 16.3. Bushings shall not be used.
5. Fitting, gasket and coupling shall be furnished by same manufacturer.
6. Galvanized, cast iron, threaded fittings, 175 psi WOG pressure rating, ANSI B16.4.
7. Fittings shall be hot-dipped galvanized when installed on galvanized piping.
8. Weld-o-lets welded to piping in fabrication shops are permitted. No welding allowed at project site.
9. Weld fittings shall be steel, standard weights, black, and in accordance with ASME B 16.9, ASME B 16.25, ASME B 16.5, ASME B 16.11 and ASTM A 234.
10. Pipe-o-lets or similar clamp on or saddle type fittings are not allowed as fittings.
11. Saddle type devices that strap or clamp onto piping are not allowed.

## **2.5 VALVES:**

### **A. Gate Valve:**

1. Acceptable manufacturers: Kennedy, Milwaukee Valve Co., Mueller, Nibco, Stockham, Victaulic.
2. Outside screw and yoke (OS&Y), gate valve, bronze body and trim or cast iron body bronze mounted and rated for 175 psi, non-shock cold water working pressure, Nibco F-607-OTS or equal.

### **B. Check Valve:**

1. Acceptable manufactures: Tyco Fire Products, Reliable, Viking Corp.
2. Iron body, bronze seat, stainless steel clapper with a replaceable rubber seal and 175 psi nonshock cold water working pressure. Viking Model G-1 or equal.

### **C. Ball Valve:**

1. Acceptable manufacturers: Nibco, Milwaukee Valve Co., Mueller, Victaulic.

### **D. Butterfly Valve:**

1. Acceptable manufacturers: Victaulic, Kennedy, Milwaukee Valve Co.
2. Victaulic Series 705 Firelock or equal for valve sizes 2-1/2" to 8".

3. Milwaukee Valve Co., Series BB or equal.
4. Kennedy Valve Co., Fig. 0IG.

E. Test and Drain Valves:

1. Acceptable manufacturers: AGF, Victaulic or equal.
2. AGF Test and Drain Victaulic Style 720 TestMaster II or equal may be installed.

F. Drain Valves:

1. Acceptable manufacturers: Kennedy, Nibco or equal.
2. Thread-in bonnet bronze globe valves rated to 175 psi non-shock cold water working pressure.
3. Low point drain valves shall have, 3/4" brass nipple with 3/4" male hose threads and cap.

## **2.6 FIRE DEPARTMENT CONNECTION**

- A. Fire department connection shall be pilaster mounted with four (4) 2½-inch inlets connected to a 6-inch pipe.
- B. Plate shall describe area of service.
- C. Finish for plate and connector shall be chrome.
- D. Exposed caps and fittings shall be chrome.

## **2.7 TAMPER SWITCH**

- A. Acceptable manufacturers: Potter, System Sensor or equal.
- B. Outside screw and yoke (OS&Y) supervisory switch, NEMA 4 enclosure, provided with 2 sets of contacts rated at 2.5 Amps at 30 VDC and 15 Amps at 125/250 VAC. Equal to Potter OSYSU-2. Provide with cover tamper kit. For areas identified as hazardous locations, provide "EX" Model.
- C. Control valve supervisory switch, NEMA 4 enclosure, provided with 2 sets of contacts rated at 2.5 Amps at 30 VDC and 15 Amps at 125/250 VAC. Equal to Potter PCVS-2. Provide with optional cover tamper kit. For areas identified as hazardous locations, provide "EX" Model.
- D. Tamper switch shall be capable of transmitting signal during first 2 revolutions of handwheel or during 1/5 of travel distance of valve control apparatus from its normal position.
- E. Unit shall be compatible with Fire Alarm System.

## **2.8 FLOW SWITCH**

- A. Acceptable manufacturers: Potter, System Sensor, or equal.

- B. Vane type waterflow switch for use in wet sprinkler systems, 450 psi service pressure rating, 10 gpm minimal flow rate to activate alarm, 2 sets of SPDT (Form C) contacts rated at 2 Amps at 30 VDC and 15 Amps at 125/250 VAC. Provide with optional cover tamper kit. Equal to Potter VSR-F.
- C. Unit shall be compatible with Fire Alarm System. Potter model VSR-F or equal.

**2.9 FLEXIBLE HOSE SPRINKLER SYSTEM SHALL BE RATED FOR THE FOLLOWING PERFORMANCE CRITERIA:**

- A. FM Approved for its intended use pursuant to FM 1637 Approval Standard for Sprinkler Hose with Threaded End Fittings.
- B. UL Listed for its intended use pursuant to UL 2443 Standard for flexible Sprinkler Hose with Fittings for Fire Protection Service.
- C. Seismically qualified for use pursuant to ICC-ES AC-156 Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems.

**2.10 MATERIALS: FLEXIBLE HOSE COMMERCIAL SPRINKLER CONNECTIONS.**

- A. Composition shall be 100% Type 304 Stainless Steel.
- B. Straight Hose Assembly Lengths:
  - 1. ¾ inch outlet
  - 2. Maximum pressure rating: 175 psi.
- C. Fully welded non-mechanical fittings, braided, leak-tested with minimum 1 inch true-bore internal corrugated hose diameter.
- D. Elbow hose assembly lengths (for use in confined spaces).
  - 1. 1/2 inch outlet
  - 2. Maximum pressure rating: 175 psi
- E. Fully welded non-mechanical fittings, braided, leak-tested with minimum 1 inch true-bore internal corrugated hose diameter.
- F. Ceiling Bracket
  - 1. Type G90 Galvanized Steel
  - 2. Type: Direct attachment type, having integrated snap-on clips ends positively attached to the ceiling using tamper resistant screws.
- G. Flexible hose attachment: Removable hub type with set screw.

## 2.11 SPRINKLER HEAD

- A. Fire sprinklers installed on wet system shall be of one manufacturer throughout the building. No mixing of sprinkler brands shall be permitted.
- B. Manufacturers: Unless otherwise noted below, shall be manufactured by Viking Corp., Tyco Fire Products or Reliable.
- C. Automatic, having temperature rating suitable for location.
- D. Light Hazard and Ordinary Hazard occupancies shall be Quick Response type sprinkler heads.
- E. Architect will review deviations from the specified styles for approval prior to installation.
- F. Provide the following type of sprinkler head.
  - 1. Unfinished areas such as areas with no ceiling, mechanical spaces, storage, etc.
    - a. Quick response, brass Upright, 1/2" orifice, ordinary temperature class (175°F),
    - b. Viking Model Microfast or equal.
    - c. Extended coverage, brass finish, Upright or Pendent, large orifice, ordinary temperature class (175°F), Viking ECOH-ELO or equal designed and installed per its listing.
  - 2. In areas with ceilings.
    - a. Concealed Pendent, 1/2" orifice, intermediate temperature class (175°F) solder link, Viking Mirage QR Concealed Pendent, Model B-2 adjustable sprinkler, with 165°F temperature rated cover plate, flush with ceiling or equal. Cover plate color shall match ceiling color and shall be factory-painted (i.e. by manufacturer).
  - 3. In unfinished areas such as elevator pits where conditions do not permit installation of upright or pendent head.
    - a. Brass Sidewall, 1/2" orifice, ordinary temperature class (175°F), Viking Model M, HSW horizontal or VSW vertical sidewall or equal.
- G. Submit samples for examination and approvals.
- H. Temperature ratings of sprinkler heads shall vary if installed close to heat sources, under skylights or in special hazard areas.
- I. Sprinkler Cabinets:
  - 1. Complete with required number of spare sprinkler heads of each type and temperature
  - 2. rating and special wrenches per NFPA 13
  - 3. Provide multiple cabinets to meet this requirement.
  - 4. Coordinate cabinet locations with Owner's representative.

## **2.12 HANGERS**

- A. Provide hangers to support piping: in perfect alignment without sagging or interference, to permit free expansion and contraction, and meet requirements of NFPA 13.
- B. Riser clamps shall not protrude more than 2" beyond edge of hole. Provide Anvil Fig. 261 or equal.
- C. Concrete expansion anchors are to be Hilti, Rawl, or Phillips concrete fasteners.

## **2.13 EARTHQUAKE BRACING**

- A. Sprinkler system shall be protected from earthquake influence in accordance with requirements of NFPA 13 and as outlined in Section 20 0549 - Seismic Anchorage and Restraints.
- B. Provide flexible couplings, bracing, and other components required, compatible with piping material and jointing system used.
- C. Seismic detailing shall be included on Fire Protection System layout shop drawings.

## **2.14 PRESSURE GAUGES**

- A. Acceptable manufacturers: Potter-Roemer, Viking or equal.
- B. Pressure gauges shall be 3-1/2", corrosion resistant moving parts, polycarbonate window, and provided with connection not smaller than 1/4" NPT.
- C. Include shutoff valve with provisions for draining on each pressure gauge.

## **2.15 DIELECTRIC FITTINGS**

- A. Acceptable manufacturers: Epco Sales, Inc., Lochinvar, Watts Regulator Co., Wilkins or equal.
- B. Insulating nipple, metal casing, inert thermoplastic lining, Clearflow dielectric fitting by Perfection Corporation.
- C. Dielectric unions 2" and smaller; dielectric flanges 2" and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets and pressure rating of not less than 175 psig at 180°F.

## **2.16 SLEEVES FOR WALL/FLOOR PENETRATIONS**

- A. Sleeves through walls and floors shall be of a type that can be made watertight and fire stopped.
  - 1. Sleeve sizes shall be as required by NFPA 13 and 14 for Earthquake Protection.



## **2.17 SIGNS**

- A. Provide standard metal signs in English in accordance with NFPA 13.
- B. Provide hydraulic calculation information signs at risers in accordance with NFPA 13.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Product Delivery
  - 1. Delivery of Materials: Delivery of all materials and equipment to the job site shall be scheduled to assure compliance with the predetermined construction schedules.
  - 2. Storage of Materials, Equipment and Fixtures: Contractor shall be responsible for storage of materials on job site, including furnishing of any storage facilities or structures required.
  - 3. Handling Materials and Equipment: Contractor shall be responsible for on-site handling of materials and equipment.
- B. Clean-up
  - 1. Maintain the premises free from accumulation of waste materials or rubbish caused by this work.
  - 2. At the completion of the work, removed all surplus materials, tools, etc., and leave the premises clean.
- C. Leak Protection
  - 1. Damage: Protect all unfinished work to prevent damage and furnish protection of all surrounding areas where necessary.
  - 2. Leak Damage: The Contractor shall be responsible during the installation and testing periods of the fire protection system for any damage to the work of others, to the building or its contents caused by leaks in any equipment, by unplugged or disconnected pipes or fittings, or by overflow, and shall pay for the necessary replacements or repairs to work of others damaged by such leakage.
- D. Safety
  - 1. All work shall be performed in compliance with the Occupational Safety and Health Act of 1970 and the Construction Safety Act Standards.
  - 2. Contractor shall attend all job safety meetings.

### **3.2 FABRICATION**

- A. Pipe Ends

1. Ream and remove burrs after cutting pipe. Standard wall pipe ends shall be welded, threaded, cut grooved, or plain end.
  2. Thin wall pipe ends shall be plain end, welded or roll grooved in accordance with the fitting manufactures' recommendation.
  3. Threads shall be in accordance with ASME B1.20.1. Each thread on light wall pipe shall be gauged before the fitting is made-up.
- B. Grooved Ends
1. Pipe minimum thickness, squareness and out-of roundness shall be in accordance with the coupling manufacturers specifications.
  2. Pipe surface shall be free of indentations, projections, or roll marks from the end of the pipe to the groove.
- C. Welding
1. No field welding of sprinkler piping shall be permitted.
  2. Headers risers, feed mains, cross mains and branch lines may be shop welded using acceptable welding fittings. Welding methods shall comply with all the requirements of AWS B2.1.
  3. Certified records shall be maintained upon the completion of each weld, welder shall stamp an imprint of their identification into the side of the pipe adjacent to the weld.

### **3.3 INSPECTION**

- A. Investigate site conditions; verify utility locations and elevations before start of excavation.
- B. Discrepancies will be forwarded to Architect/Engineer before proceeding with construction

### **3.4 INSTALLATION**

- A. A clean set of prints or shop drawings shall be maintained at the site and marked up to show any changes.
- B. Piping shall be installed above ceilings except in areas where there is no ceiling. Install piping in exposed areas as high as possible using necessary fittings and auxiliary drains to maintain maximum clear head room.
- C. Install hydraulically designed sprinkler system and associated accessories according to requirements of NFPA 13 and as shown on drawings.
- D. Install pipe and fittings according to recommendations of pipe manufacturer.
- E. Keep materials within listed temperature range to assure jointing in accordance with manufacturer's requirements.
- F. Pipe and fittings shall be of corresponding materials when assembled.

- G. For underground pipe, in lieu of thrust blocks; anchors and tie rods can be provided. Tie rods shall be 3/4" diameter steel rod. Clamps shall be 3/8" thick by 2" wide steel. Each clamp shall be secured with four 5/8" diameter bolts.
- H. Apply asphaltum or corrosion inhibitive paint to tie rods, clamps and bolts of underground pipe.
- I. Provide readily removable fittings at end of cross-mains. Minimum size of flushing connection shall be 2".
- J. Provide test connection for each flow switch.
- K. Discharge test connections inside building to receptacles provided as part of plumbing system or to drain standpipe.
- L. Drain line detailed adjacent to sprinkler risers shall be considered as part of Sprinkler System from combination test/auxiliary drain valve for each zone or sub-zone shown on plans to plumbing receptacle.
- M. Provide auxiliary drains at low points of systems. Where trapped section of pipe exceeds 5 gallons, drain shall consist of, as a minimum: valve, 3/4" brass nipple with 3/4" male hose threads, and cap.
- N. Identify valve with brass tag denoting which flow switch is being tested, when test valves are located remote from flow switch.
- O. Clamp-on or saddle type fittings are not allowed. Outlet fittings inserted into holes drilled into piping or pipe-o-lets are not allowed.
- P. Provide reducing fittings or provide shop fabricated weld-o-lets to change pipe sizes in sprinkler systems. No bushings or grooved reducing couplings, such as Victaulic Style 750, are allowed.
- Q. Feed sprinkler heads, installed in finished ceilings, with swing joint or return bend arrangement for final positioning in ceiling grid pattern during construction phases. Sprinklers are required to be installed in the center of ceiling tiles.
- R. Provide minimum 1" outlets with sprigs or drops for sprinklers located in shelled spaces.
- S. Provide tamper switch on each shutoff valve.
- T. Provide locking device with each shutoff valve to prevent inadvertent closing of valve. Keys shall be indexed to identify valve location.
- U. Install sprinkler heads as recommended by manufacturer. Sprinklers shall be set level and at locations to avoid interference with spray pattern of sprinkler. When ducts and lights are obstructions to sprinkler distribution, provide additional heads beneath obstruction.
- V. Make joints of threaded pipe by cutting pipe square and reaming inside.
- W. Coat exposed threads with corrosion inhibitive paint. Use joint compound sparingly.

- X. Install joints for mechanical coupled pipe according to manufacturer's recommendations. Use manufacturer's gasket lubricant sparingly.
- Y. Pipe shall be cut grooved for Schedule 40 steel pipe or roll grooved for Schedule 10 steel pipe as specified by coupling manufacturer.
- Z. Welded joints shall be made in fabrication shop. No welding allowed at project site.
- AA. Hang pipe from building members using concrete inserts or beam clamps. Expansion type inserts may be used for branch piping.
- BB. Support piping in accordance with NFPA 13 Seismic Anchorage and Restraints, and in accordance with State and Local seismic restraint requirements.
- CC. Provide seismic restraint details and calculation with sprinkler shop drawings.
- DD. Provide pressure gauges as required in manufacturer's installation instructions, and as required per NFPA.
- EE. Generally install capped tees in lieu of couplings for future connections.

### **3.5 SPRINKLERS**

#### **A. General**

- 1. Sprinklers below ceilings off of exposed piping shall be listed and approved regular bronze upright type, in upright position. Listed and approved regular bronze pendent type may be used where necessary due to clear height requirements, duct interference, etc.
- 2. Pendent sprinklers shall be installed where suspended ceilings are located shall be concealed type and center of tile.
- 3. Sprig-ups shall be provided wherever necessary to provide proper deflector distances in accordance with NFPA 13 requirements.
- 4. Provide flex head for suspended T-bar ceiling to accommodate 1" minimum seismic movement.
- 5. Provide sprinkler below duct with minimum width 4 ft and above.

#### **B. Sprinkler Guards and Water Shields**

- 1. Provide guards on sprinklers within 7 feet of finished floor or wherever sprinklers may be subject to mechanical damage.

#### **C. Drains**

- 1. Provide main drain valves at system control valves, sized in accordance with NFPA 13 and AHJ requirements that extend piping to exterior.
- 2. Provide all auxiliary drains where necessary.
- 3. Pipe all drains and auxiliary drains to locations where water drained will not damage stock, equipment, vehicles, planted areas, etc., or injure personnel.
- 4. Plugs used for auxiliary drains shall be brass.

5. All piping and fittings downstream of drain valve and gang drain shall be hot-dipped galvanized.
6. The Contractor shall comply with all water discharge restrictions.

### **3.6 VALVES**

#### **A. General**

1. Valves shall be installed with sufficient clearance for operation, testing and maintenance.
2. Where wafer bodied valves are used, they shall be installed so that the discs do not interfere with other components.

#### **B. Control valves shall be installed so that valve position indicator is visible.**

#### **C. Drain, test, and trim valves.**

1. Valves shall be installed no more than 7 feet 0 inches above the finished floor and shall be accessible.

#### **D. Backflow Preventers**

1. Install backflow preventers of reduced pressure detector assembly type with clearances required by AHJ and in compliance with manufacturer's recommendations for inspection, testing and maintenance.

#### **E. Floor Control Valves**

1. Provide floor control valve assemblies within the stair enclosure on all floors. Each floor control valve assembly shall be equipped with a control valve, tamper switch, flow switch, inspector's test/drain trim assembly, pressure-relief valve not less than ½-inch in size and set to operate at 175 psi, and pressure-reducing device set at
2. Pressure-reducing valves will require discharging to a gang drain.

### **3.7 FIRE DEPARTMENT CONNECTIONS**

#### **A. Install with centerline of inlets neither less than 18 inches nor more than 48 inches above the finished grade or pavement.**

#### **B. Piping from fire department connection to check valve shall be hot-dipped galvanized.**

### **3.8 PRESSURE GAUGES**

#### **A. Gauges shall be located where not subject to freezing.**

#### **B. Gauges shall be provided vertically, with three-way valve with 1/4-inch plugged outlet, and as follows:**

1. Above and below wet system riser check valves.

2. At each water supply and inlet of floor control valve.

### **3.9 HANGERS, SUPPORTS, AND EARTHQUAKE BRACING**

#### **A. General**

1. All piping must be substantially supported from building structure and only approved types of hangers shall be used. Piping lines under ducts shall not be supported from duct work, but shall be supported from building structure with trapeze hangers where necessary or from steel angles supporting duct work in accordance with NFPA 13.
2. All thread rods shall not be bent.
3. Hanger components shall be ferrous.
4. Powder driven studs shall be specifically listed for use in the required seismic zone.

#### **B. Feed and Cross Mains**

1. Install at least one hanger per length of pipe up to 8 feet in length joined by grooved couplings.
2. Use flexible couplings where more than two couplings are used per run.

#### **C. Risers**

1. Standpipes shall be supported at lowest level and alternate levels above using riser clamp.
2. Provide flexible couplings in standpipe.

#### **D. System Headers**

1. Install pipe saddle supports complete with flange bolted to floor.

#### **E. Earthquake Protection**

1. Install flexible joints and sway braces in accordance with NFPA 13, Section 9.3.

### **3.10 SLEEVINGS, WALL AND FLOOR PENETRATIONS**

- A. Set Schedule 40 sleeves in place for all pipes passing through openings in fire resistance rated construction when required by UL listing for fire stopping method utilized.
- B. Provide clearance between the sprinkler piping and sleeves in accordance with NFPA and FM. The space between sleeve and pipe shall be filled with noncombustible, UL listed fire stopping materials. Provide chrome wall plates at each side of wall.
- C. Sleeves through floors shall be watertight. Penetrations through fire rated construction shall be adequately fire stopped to maintain the fire resistance rating required.

### **3.11 SIGNS**

#### **A. Valves**

1. Secure to each valve with corrosion resistant wire or chain, sign stating, "Control valve."

B. Hydraulic Design Information

1. Secure to each system riser with corrosion resistant fasteners.

**3.12 WATER FLOW ALARMS AND SUPERVISORY DEVICES**

A. Alarm Bells

1. Electric bells and wiring diagrams shall be delivered to the alarm contractor for installation and wiring.

B. Alarm and Supervisory Switches

1. Deliver wiring diagrams to alarm contractor.
2. Install alarm water flow switches in accordance with switch and valve manufacturers' instructions.
3. Install and adjust valve supervisory switches in accordance with switch manufacturers' instructions.

**3.13 INSPECTOR'S TEST**

- A. Provide inspector's test connections, as specified in NFPA 13, at required points for testing each waterflow alarm device. Special discharge nozzle shall have same size orifice as smallest orifice sprinklers installed.
- B. Provide 1-inch sight glass if inspector's test discharge cannot be readily observed while operating valve.
- C. Pipe all inspector's test connections discharging to atmosphere to location where water drained will not damage stock, equipment, vehicles, planted areas, etc., or injure personnel.
- D. Splash blocks shall be provided where inspector's test discharge could produce damage to surroundings.
- E. All pipe and fittings downstream of inspector's test valve shall be galvanized.

**3.14 SYSTEM ACCEPTANCE**

A. Tests

1. General system test shall be coordinated with the Owner's representatives for training and witnessed by the AHJ and Owner's commissioning agent. Problems noted during testing such as air or water leaks, difficulty in operating valves, alarm failures, etc. shall be corrected before the Contractor leaves the job.
2. Hydrostatically test all piping, including fire department connections between the check valve and connection, at 200 psi for two hours. If the highest static pressure at the lowest

point in the system exceeds 150 psi, the system shall be tested at 50 psi more than the highest static pressure.

3. Flow Tests

- a. Main drain shall be opened wide until pressure stabilizes then slowly closed, noting and recording flowing (residual) and static (non-flow) pressure.
- b. Pilot-operated pressure-reducing valves shall be tested as specified in (b). Adjust pilot for design pressures.
- c. Backflow preventers shall be forward-flow tested.

4. Pipe shall not be concealed until satisfactorily pressure tested.

5. Conduct drain test. Record static pressure and residual pressure per NFPA 13.

6. Owner's representative or engineer may witness tests. Contractor shall notify Owner and Engineer a minimum of 3 days in advance to allow for participation.

7. Log of tests shall be kept at job site and shall identify:

- a. Who performed test.
- b. Time of test.
- c. Date of test.
- d. Section of system tested.
- e. Results of test.
- f. Along with completed Contractor's Material and Test Certification form(s) from NFPA 13 and NFPA 14.

8. Operate flow switches to test that signals are transmitted to Fire Alarm Control Panel.

9. Include test for tamper switches.

B. Valve Operation

1. Operate each valve through its entire range. Adjust valve packing glands.

- a. Hose valves shall be capped during the test.

2. Threads for hose valve/wall hydrant outlets and fire department inlets shall be verified to conform to those used by the AHJ.

C. Water Flow and Supervisory Devices

1. Coordinate testing of electric components with the alarm contractor.

2. Each water flow device shall be tested in accordance with NFPA 72 by opening the inspectors test or alarm test valve.

3. Each valve supervisory device shall be tested by operating the valve wheel/crank.

4. Verify all signals have been noted by the fire alarm control panel and each audible alarm device operates.

D. Contractor's material and test certificates shall be completed for each system/floor and signed by the Contractor and witnessed by the Owner's representative/AHJ.

E. Training



1. General – In addition to the tests required in Parts A through C and witnessed by the Owner’s representative(s), conduct one/two hour training sessions to familiarize the representatives with all operating features of the system, including control valve, drain and test valve locations and operations.
2. Provide Owner’s representatives with:
  - a. A small-scale plan of the system/building showing locations of control, drain and test valves.
  - b. Component manufacturers’ inspection and testing manuals.
  - c. Two copies of NFPA 25.
3. Spare Parts
  - a. Provide 12 spare sprinklers of all types and ratings that are installed, in a steel cabinet complete with special sprinkler wrenches. Install cabinet as directed by Owner.

### **3.15 ADJUSTMENT AND CLEANING**

- A. Cleaning: Flush all piping in accordance with NFPA Standards for test procedures.
- B. Ensure underground feed pipe has been flushed, to clear out construction debris, prior to connecting aboveground fire protection system to it.
- C. Maintain the premises free from accumulation of waste materials or rubbish caused by this work

### **3.16 BONDING**

- A. Provide underground cast iron and underground ductile iron pipe with metallic bond at each joint.
- B. Bond wire shall be type RHW-USE size 1/0 neoprene-jacketed copper conductor shaped to stand clear of joint.

**END OF SECTION 21 13 13**

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**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

## **SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
  2. Dielectric fittings.
  3. Mechanical sleeve seals.
  4. Sleeves.
  5. Escutcheons.
  6. Grout.
  7. Plumbing demolition.
  8. Equipment installation requirements common to equipment sections.
  9. Concrete bases.
  10. Supports and anchorages.

#### **1.2 DEFINITIONS**

- A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, space above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

#### **1.3 SUBMITTALS**

- A. Welding certificates.

#### **1.4 QUALITY ASSURANCE**

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- D. Commissioning
  - 1. Commissioning requires the participation of Division 22 plumbing contractor to work to ensure that all systems are operating in a manner consistent with the construction documents and the design intent. The general commissioning requirements and coordination are detailed in Division 1 and in Division 23. This Division shall be familiar with all parts of Division 1 and Division 23 and the commissioning plan issued by the Commissioning Authority and shall execute all commissioning responsibilities assigned to them in the Contract Documents.
  - 2. The plumbing contractor is responsible for assisting the commissioning agent throughout the entire commissioning process on the work under their section. The work is not complete until the commissioning agent and the College has signed off on the commissioned systems.

### **PART 2 - PRODUCTS**

#### **2.1 PIPE, TUBE, AND FITTINGS**

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

#### **2.2 JOINING MATERIALS**

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
  - 1. ABS Piping: ASTM D 2235.
  - 2. CPVC Piping: ASTM F 493.
  - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - 4. PVC to ABS Piping Transition: ASTM D 3138.

### **2.3 DIELECTRIC FITTINGS**

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

### **2.4 MECHANICAL SLEEVE SEALS**

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Carbon steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## **2.5 SLEEVES**

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

## **2.6 ESCUTCHEONS**

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated.

## **2.7 GROUT**

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## **PART 3 - EXECUTION**

### **3.1 PLUMBING DEMOLITION**

- A. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
  - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
  
- B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### **3.2 PIPING SYSTEMS - COMMON REQUIREMENTS**

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. 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.
- 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 to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.

- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using 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.
  - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.



- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. 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.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. 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.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic 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. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
  - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  - 5. PVC Non-pressure Piping: Join according to ASTM D 2855.
  - 6. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D 3138 Appendix.

### **3.4 PIPING CONNECTIONS**

- A. 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. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### **3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS**

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### **3.6 CONCRETE BASES**

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

### **3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES.**

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### **3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES**

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

### **3.9 GROUTING**

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

**END OF SECTION 22 05 00**

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**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

## SECTION 22 05 17 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Sleeves.
  2. Sleeve-seal systems.
  3. Grout.

#### 1.2 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 water stop 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, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Metraflex Inc.

2. CALPICO, Inc.
  3. Advance Products & Systems, Inc Pipeline Seal and Insulator, Inc.
  4. Proco Products, Inc.
- C. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  2. Pressure Plates: Carbon steel.
  3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, Stainless steel 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: Non-shrink; 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 Division 07 Section "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 Division 07 Section "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 Cast-iron wall sleeves.
    - b. Piping NPS 6 and Larger: Cast-iron 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-on-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.
4. Concrete Slabs above Grade:
  - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
  - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
5. 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 22 05 17**



## **SECTION 22 05 18 - ESCUTCHEONS FOR PLUMBING PIPING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Escutcheons.
  - 2. Floor plates.

#### **1.2 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 and rough-brass 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.

#### **2.2 FLOOR PLATES**

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

### **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 Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
  
  - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
  - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
  
  - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
  - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
  
  - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
  - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.
- 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.

### 3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

**END OF SECTION 22 05 18**

## SECTION 22 05 19 - METERS AND GAGES FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Liquid-in-glass thermometers.
  2. Dial-type pressure gages.
  3. Gage attachments.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product certificates.
- C. Operation and maintenance data.

### 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, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of 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.
  3. Standard: ASME B40.200.
  4. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
  5. Case Form: Adjustable angle unless otherwise indicated.
  6. Tube: Glass with magnifying lens and blue or red organic liquid.

7. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in deg F (deg C).
8. Window: Glass.
9. Stem: Aluminum and of length to suit installation.
  - a. Design for Thermowell Installation: Bare stem.
10. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.
12. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Ernst Flow Industries.
  - b. Marsh Bellofram.
  - c. Miljoco Corporation.
  - d. Palmer Wahl Instrumentation Group.
  - e. REOTEMP Instrument Corporation.
  - f. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  - g. Weiss Instruments, Inc.
  - h. WIKA Instrument Corporation - USA.
13. Standard: ASME B40.200.
14. Case: Plastic; 7-inch (178-mm) nominal size unless otherwise indicated.
15. Case Form: Adjustable angle unless otherwise indicated.
16. Tube: Glass with magnifying lens and blue or red organic liquid.
17. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C).
18. Window: Glass.
19. Stem: Aluminum and of length to suit installation.
  - a. Design for Thermowell Installation: Bare stem.
20. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
21. 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 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings or comparable product by one of 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. Terice, 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.
- 3. Standard: ASME B40.100.
  - 4. Case: Liquid-filled; cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
  - 5. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
  - 6. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
  - 7. Movement: Mechanical, with link to pressure element and connection to pointer.
  - 8. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi.
  - 9. Pointer: Dark-colored metal.
  - 10. Window: Glass.
  - 11. Ring: Metal.
  - 12. Accuracy: Grade A, plus or minus 1 percent of middle half of Grade B scale range.

## **2.3 GAGE ATTACHMENTS**

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install thermowells with socket extending [a minimum of 2 inches into fluid one-third of pipe diameter to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. 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.
- K. 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.
- L. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
- M. Adjust faces of meters and gages to proper angle for best visibility.

### 3.2 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
  - 1. Liquid-filled Sealed, bimetallic-actuated type.
  - 2. Industrial-style, liquid-in-glass type.
- B. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be[ one of] the following:
  - 1. Liquid-filled Sealed, bimetallic-actuated type.
  - 2. Industrial-style, liquid-in-glass type.
- C. Thermometer stems shall be of length to match thermowell insertion length.

### **3.3 THERMOMETER SCALE-RANGE SCHEDULE**

- A. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg F.
- B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.

### **3.4 PRESSURE-GAGE SCHEDULE**

- A. Pressure gages at discharge of each water service into building shall be one of the following:
  - 1. Liquid-filled Sealed Solid-front, pressure-relief -mounted, metal case.
  - 2. Sealed, direct -mounted, plastic case.
- B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:
  - 1. Liquid-filled Sealed Solid-front, pressure-relief, direct-mounted, metal case.
  - 2. Sealed, direct remote-mounted, plastic case.
- C. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:
  - 1. Liquid-filled Sealed Solid-front, pressure-relief direct -mounted, metal case.
  - 2. Sealed, direct -mounted, plastic case.

### **3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE**

- A. Scale Range for Water Service Piping: 0 to 160 psi.
- B. Scale Range for Water Service Piping: 0 to 200 psi.
- C. Scale Range for Domestic Water Piping: 0 to 160 psi.
- D. Scale Range for Domestic Water Piping: 0 to 200 psi.

**END OF SECTION 22 05 19**

**P2S Inc.**  
005.2882.000

January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California



## **SECTION 22 05 23 - GENERAL DUTY VALVES FOR PLUMBING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Bronze swing check valves.
4. Bronze gate valves.
5. Bronze globe valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

#### **1.2 SUBMITTALS**

- A. Product Data: For each type of valve indicated.

#### **1.3 QUALITY ASSURANCE**

- A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- B. NSF Compliance: NSF 61 for valve materials for potable-water service.

### **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. 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.
  
- E. 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 BRASS BALL VALVES

- A. Three-Piece, Full-Port, Brass Ball Valves with Brass Trim:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Nibco Inc.
    - b. Crane Co.; Crane Valve Group
    - c. DynaQuip Controls.
    - d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
    - e. Hammond Valve.
    - f. Jamesbury; a subsidiary of Metso Automation.
    - g. Jomar International, LTD.
    - h. Kitz Corporation.
    - i. Legend Valve.
    - j. Marwin Valve; a division of Richards Industries.
    - k. Milwaukee Valve Company.
    - l. Red-White Valve Corporation.
  
  - 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: Forged brass.
    - f. Ends: Threaded.
    - g. Seats: PTFE or TFE.
    - h. Stem: Brass.
    - i. Ball: Chrome-plated brass.
    - j. Port: Full.

### **2.3 BRONZE BALL VALVES**

A. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
  - a. Nibco Inc.
  - b. American Valve, Inc.
  - c. Conbraco Industries, Inc.; Apollo Valves.
  - d. Crane Co.; Crane Valve Group; Crane Valves.
  - e. Hammond Valve.
  - f. Lance Valves; a division of Advanced Thermal Systems, Inc.
  - g. Legend Valve.
  - h. Milwaukee Valve Company.
  - i. Red-White Valve Corporation.
  - j. 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 BRONZE SWING CHECK VALVES**

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Nibco Inc.
  - b. American Valve, Inc.
  - c. Crane Co.; Crane Valve Group
  - d. Hammond Valve.
  - e. Kitz Corporation.
  - f. Milwaukee Valve Company.
  - g. Powell Valves.
  - h. Red-White Valve Corporation.
  - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

**B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Nibco Inc.
  - b. Crane Co.; Crane Valve Group
  - c. Hammond Valve.
  - d. Kitz Corporation.
  - e. Milwaukee Valve Company.
  - f. Red-White Valve Corporation.
  - 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.

## **2.5 BRONZE GATE VALVES**

**A. Class 125, NRS Bronze Gate Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Nibco Inc.
  - b. American Valve, Inc.
  - c. Crane Co.; Crane Valve Group
  - d. Hammond Valve.
  - e. Kitz Corporation.
  - f. Milwaukee Valve Company.
  - g. Powell Valves.
  - h. Red-White Valve Corporation.
  - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - j. Zy-Tech Global Industries, Inc.
2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.

B. Class 125, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Nibco Inc.
  - b. American Valve, Inc.
  - c. Crane Co.; Crane Valve Group
  - d. Hammond Valve.
  - e. Kitz Corporation.
  - f. Milwaukee Valve Company.
  - g. Powell Valves.
  - h. Watts Regulator Co.; a division of Watts Water Technologies, 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 or solder joint.
  - e. Stem: Bronze.
  - f. Disc: Solid wedge; bronze.
  - g. Packing: Asbestos free.

## 2.6 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Nibco Inc.
  - b. Crane Co.; Crane Valve Group
  - c. Hammond Valve.
  - d. Kitz Corporation.
  - e. Milwaukee Valve Company.
  - f. Powell Valves.
  - g. Red-White Valve Corporation.
  - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem and Disc: Bronze.
- f. Packing: Asbestos free.

**B. Class 125, Bronze Globe Valves with Nonmetallic Disc:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Nibco Inc.
  - b. Crane Co.; Crane Valve Group
  - c. Red-White Valve Corporation.
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.

## **PART 3 - EXECUTION**

### **3.1 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.
  1. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

### **3.2 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.

### **3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS**

- A. If valve applications are not indicated, use the following:
1. Shutoff Service: Ball, or Gate valves.
  2. Throttling Service: Globe or ball, valves.
  3. Pump-Discharge Check Valves:
    - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
    - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring.
    - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class 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.

### **3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE**

- A. Pipe NPS 2 and Smaller:
1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
  2. Ball Valves: Two piece, full port, brass or bronze with brass trim.
  3. Bronze Swing Check Valves: Class 125, bronze disc.
  4. Bronze Gate Valves: Class 125, NRS.
  5. Bronze Globe Valves: Class 125, bronze disc.

### **3.5 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE**

- A. Pipe NPS 2 and Smaller:
1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
  2. Ball Valves: Two piece, full port, brass or bronze with brass trim.
  3. Bronze Swing Check Valves: Class 125, bronze disc.

4. Bronze Gate Valves: Class 125, NRS.
5. Bronze Globe Valves: Class 125, bronze disc.

**END OF SECTION 22 05 23**



## SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Scope: This section specifies pipe and equipment hangers, brackets, and supports. Pipe supports shall be furnished complete with all necessary inserts, bolts, nuts, rods, washers and other accessories. Piping seismic restraints are specified in Section 22 05 49.
- B. Operating Conditions: The hangers and supports specified in this section are provided to resist pipe loads occurring primarily in the downward (gravity) direction. For the purpose of pipe hanger and support selection, this section establishes pipe support classifications based on the operating temperatures of the piping contents. Pipe support classifications are as follows:
1. Cold Systems: 33°F to 59°F.
  2. Ambient Systems: 60°F to 119°F.
  3. Hot Systems: 105°F to 200°F.
- C. Hanger and Support Selection:
1. In certain locations, pipe supports, anchors, and expansion joints have been indicated on the Drawings, but no attempt has been made to indicate every pipe support, anchor and expansion joint. It shall be the Contractor's responsibility to provide a complete system of pipe supports, to provide expansion joints, and to anchor all piping, in accordance with the requirements set forth herein. Additional pipe supports may be required adjacent to expansion joints, couplings, or valves.
  2. Concrete or fabricated steel and FRP supports shall be as indicated on the Drawings, as specified in other sections, or, in the absence of such requirements, as permitted by the University's representative.
  3. The Contractor shall select pipe hangers and supports as specified in this Section. Stock hanger and support components shall be used wherever practical. Selections shall be based upon the pipe support classifications specified in this Section.
  4. The Contractor shall review the piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the type of support to be used at each hanger point.
  5. All piping shall be rigidly supported and anchored so there is no movement or visible sagging between supports.
  6. Hangers and supports shall withstand all static and specified dynamic conditions of loading to which the piping and associated equipment may be subjected. As a minimum, consideration should be given to the following conditions:
    - a. Weights of pipe, valves, fittings, insulating materials, suspended hanger components, and normal fluid contents.
    - b. Weight of hydrostatic test fluid or cleaning fluid if normal operating fluid contents are lighter.

- c. Reaction forces due to the operation of safety or relief valves.
  - d. Wind loadings on outdoor piping.
- 
- 7. Hangers and supports shall be sized to fit the outside diameter of pipe, tubing, or, where specified, indicated or required, the outside diameter of insulation.
  - 8. Where negligible movement occurs at hanger locations, rod hangers should be used for suspended lines, wherever practical. For piping supported from below, bases, brackets or structural cross members should be used.
  - 9. Hangers for the suspension of size 2-1/2 inches and larger pipe and tubing shall be capable of vertical hanger component adjustment under load.
  - 10. The supporting systems shall provide for and control the free or intended movement of the piping including its movement in relation to that of connected equipment.
  - 11. Where there is horizontal movement at a suspended type hanger location, hanger components shall be selected to allow for swing. The vertical angle of the hanger rod shall not, at any time, exceed 4 degrees.
  - 12. To allow for isolation of pipe from structure, there shall be no contact between a pipe and hanger or support component. Use felt isolator inserts, rubber, plastic or vinyl coated, or felt lined hanger and support components.
  - 13. Unless otherwise specified, existing pipes and supports shall not be used to support new piping.
  - 14. Unless otherwise specified, pipe support components shall not be attached to pressure vessels.
  - 15. Plumber's tape shall not be used to support piping.

## 1.2 QUALITY ASSURANCE

- A. References: This section contains references to the following standards for manufacturer and installation requirements. They are a part of this section in their entirety or as specifically modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail. In case of conflict between the listed documents, the more stringent requirement shall prevail.

AISC M016	Manual of Steel Construction - 9th Edition
ASME B31.1	Power Piping
ASME B31.2	Fuel Gas Piping
ASME B31.9	Building Services Piping
ASTM E84	Surface Burning Characteristics of Building Materials, Test Method for
MSS SP58	Pipe Hangers and Supports - Materials, Design and Manufacturer.
MSS SP69	Pipe Hangers and Supports - Selection and Application.
NFPA 13	Installation of Sprinkler Systems.
NFPA 14	Installation of Standpipe and Hose Systems.
SMACNA	Seismic Restraint Manual Guidelines for Mechanical Systems.
UL 203	Pipe Hanger Equipment for Fire Protection Service

- B. Supports for Mechanical Systems and Plumbing Piping Systems: In conformance with MSS SP-58 and SP-69.

- C. Supports for Sprinkler Piping: In conformance with minimum requirements as established in NFPA 13.
- D. Supports for Standpipes: In conformance with minimum requirements as established in NFPA 14.

### **1.3 SUBMITTALS**

- A. Submit the following under provisions of paragraph 22 05 00-1.11:
  - 1. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
  - 2. Product Data: Provide manufacturers catalog data including load capacity.
  - 3. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. For every piece of material or equipment with an operating weight of 500 pounds or more, the Contractor shall submit a design support drawing prepared and sealed by a California Licensed Structural Engineer. All designs shall conform to 2019 CBC requirements.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE PRODUCTS**

- A. Standard pipe supports and components shall be manufactured by B-Line, Carpenter & Patterson, Kin-Line, ITT Grinnell, Michigan, Pipe Shields Incorporated, Superstrut, Unistrut, Tolco, Piping Technology & Products, Inc. or equal.
- B. Plumbing Piping - DWV:
  - 1. Conform to ASME B31.9, MSS SP58 and MSS SP69.
  - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, and split ring.
  - 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
  - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  - 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
  - 6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
  - 7. Vertical Support: Steel riser clamp.
  - 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - 9. Pipe Support (all pipe materials): Carbon steel ring, adjustable. Isolators shall be B-Line vibra clamp and cushion, Super Strut, Stoneman, "Trisolator", or approved equal.
- C. Plumbing Piping - Water:
  - 1. Conform to ASME B31.9, MSS SP58 and MSS SP69.
  - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, and split ring.
  - 3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
  - 4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.

5. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
9. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
10. Vertical Support: Steel riser clamp.
11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
12. Pipe Support (all pipe materials): Carbon steel ring, adjustable. Isolators shall be B-Line vibra clamp and cushion, Super Strut, Stoneman, "Trisolator", or approved equal.

D. Hydronic Piping:

1. Conform to ASME B31.9, MSS SP58 and MSS SP69.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring, and spring hanger.
3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis, spring hanger.
4. Hangers for Hot Pipe Sizes 2 to 6 Inches: Carbon steel, adjustable, roller, spring hanger.
5. Hangers for Hot Pipe Sizes 6 Inches and Over: Not Used.
6. Pipe Anchor:
  - a. Manufacturers:
    - 1) Piping Technology & Products, Inc.
    - 2) ITT Grinnell
    - 3) B-Line
    - 4) Or equal.
  - b. Factory fabricated, double saddle, welded construction, made of high strength carbon steel.
  - c. Anchor shall be capable of withstanding a deadweight (downward force) equivalent to the weight 28 feet of Sch.40 pipe filled with water of the pipe size it supports.
  - d. Provide with critical dimensions as indicated on the Drawings.
  - e. Anchors shall be degreased, and deburred, shop coat primed and ready for welding when delivered to the jobsite.
  - f. Pipe anchor shall be capable of withstanding a lateral seismic force equal to 0.6 times the deadweight force. Pipe anchor shall be capable of withstanding an axial thrust load equal to 1/2 of the deadweight force.
7. Pipe Slide Support Assembly:
  - a. Manufacturers:
    - 1) Piping Technology & Products, Inc.
    - 2) ITT Grinnell

- 3) B-Line
    - 4) Or equal.
  - b. Factory fabricated, (2) piece assembly, as indicated on the Drawings.
  - c. Top piece shall consist of saddle support with double U-bolt hold down assembly. Assembly shall be completely factory fabricated and have slots for the four (4) hold down bolts of the bottom assembly. Slots shall be sized as follows:
    - 1) Chilled Water: Provisions for 3/4" slide, either direction along pipe axis.
    - 2) Refer to the front and side view shown on the drawings.
  - d. Assembly shall be capable of withstanding a downward deadweight force equal to the weight of 28 feet of Schedule 40 pipe filled with water of the pipe size it supports. Assembly shall also be capable of withstanding a lateral or tangential seismic horizontal force equal to 0.6 times the deadweight.
8. Pipe Guide Assembly:
  - a. Manufacturers:
    - 1) Piping Technology & Products, Inc.
    - 2) ITT Grinnell
    - 3) B-Line
    - 4) Or equal.
  - b. Factory fabricated, two (2) piece, welded construction, and made entirely of carbon steel.
  - c. Unit shall consist of retainer outer tube and spider slide/pipe clamp assembly.
  - d. Assembly shall be capable of withstanding a downward deadweight force equal to the weight of 28 feet of Schedule 40 pipe filled with water of the pipe size it supports. Assembly shall also be capable of withstanding a lateral or tangential seismic horizontal force equal to 0.6 times the deadweight.
9. Elbow Supports:
  - a. Welded steel pipe stand with steel base plate anchored and grouted to floor, seismic spring support and welded steel extension off pipe elbow. Use U-bolt cradle where support is below horizontal pipe; refer to the Drawings.
  - b. Spring shall have minimum 2" deflection.
10. Wall Support for Pipe Sizes to 4" shall be as indicated on the Drawings.

## 2.2 STRUCTURAL ATTACHMENTS

- A. Steel beam clamp with Eye Nut: Beam clamp and eye nut shall be forged steel. Configuration and components shall comply with MSS and FEDSPEC Type 28. Grinnell Fig. 292, Carpenter & Patterson Fig. 297, or equal.

- B. Welded Beam Attachment: Beam attachment shall be carbon steel and comply with MSS and FEDSPEC Type 22. B-Line B3083, Grinnell Fig. 66, or equal.
- C. Welded Steel Bracket: Bracket shall be carbon steel and comply with MSS Type 32 and FEDSPEC Type 33 for medium welded bracket shall comply with MSS Type 33 and FEDSPEC Type 34.
- D. Beam “C” Clamp with Locknut and Retaining Strap: Beam clamp and locknut shall be forged steel. Configuration and components shall comply with MSS and FEDSPEC Type 19. Tolco Fig. 65 or 66 with Fig. 69 retaining strap, B-Line B3036 with B3362 strap, or equal.
- E. Concrete Wall Attachment: Concrete wall attachments shall conform to SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.

### **2.3 ACCESSORIES**

- A. Hanger Rods: Rods shall be carbon steel or 304 stainless steel, threaded on both ends or continuous threaded and sized as specified.
- B. Weldless Eye Nut: Eye nut shall be forged steel and shall comply with MSS and FEDSPEC Type 17. Eye nut shall be Grinnell Fig. 290, B-Line B2300, or equal.
- C. Welded Eye Rod: Eye rod shall be carbon steel with eye welded closed. Inside diameter of eye shall accommodate a bolt diameter 1/8 inch larger than the rod diameter. Eye rod shall be Grinnell Fig. 278, B-Line B2311, or equal.
- D. Turnbuckle: Turnbuckle shall be forged steel and shall comply with MSS and FEDSPEC Type 15. Turnbuckle shall be Grinnell Fig. 230, B-Line B2311, or equal.
- E. Metal Framing Channel: Framing channel shall conform to the Metal Framing Manufacturers Association Standard MFMA-1. Framing channel shall be 1-5/8 inches square, roll formed, and 12-gage carbon steel. Channel shall have a continuous slot along one side with inturred clamping ridges. Framing channel shall be Unistrut P-1000 series, Superstrut A-1200 series, or equal.
- F. Vinylester Resin Fiberglass Framing Channel: Framing channel shall conform to ASTM E84 and shall be Class 1 fire-rated. Framing channel shall be 1-5/8” square. All channels shall be supplied with integral notches at 1” on center. Notches shall be located on the interior flange to prevent stoppage of pipe clamps and fittings after installation. Seal exposed glass fibers at cuts with manufacturer’s sealant. Framing channel shall be StruTech, Series 200, vinylester resin fiberglass or equal (no known equal).
- G. Thermal Pipe Hanger Shield: Thermal shields shall be provided at hanger, support and guide locations on pipe requiring insulation. The shield shall consist of an insulation layer encircling the entire circumference of the pipe and a steel jacket encircling the insulation layer. The thermal shield shall be the same thickness as the piping system insulation. The vapor barrier shield shall be used for cold systems. Stainless steel band clamps shall be used where specified to ensure against slippage between the pipe wall and the thermal shield.

## **2.4 INSERTS:**

- A. Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

## **PART 3 - EXECUTION**

### **3.1 INSERTS**

- A. Provide inserts for placement in concrete formwork.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

### **3.2 PIPE HANGER AND SUPPORT LOCATIONS**

- A. The Contractor shall locate hangers and supports as near as possible to concentrated loads such as valves, flanges, etc. Locate hangers, supports and accessories within the maximum span lengths specified in the project specifications to support continuous pipeline runs unaffected by concentrated loads.
- B. At least one hanger or support shall be located within 2 feet from a pipe change in direction.
- C. The Contractor shall locate hangers and supports to ensure that connections to equipment, tanks, etc., are substantially free from loads transmitted by the piping.
- D. Where piping is connected to equipment, a valve, piping assembly, etc. that will require removal for maintenance, the piping shall be supported in such a manner that temporary supports shall not be necessary for this procedure.
- E. Pipe shall not have pockets formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings.
- F. Support horizontal cast iron pipe within 18 inches of each joint.
- G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor level, not to exceed 8 feet on center spacing.

### 3.3 INSTALLATION

- A. Welded and bolted attachments to the building structural steel shall be provided where required and shall be in accordance with the requirements of SMACNA Seismic Restraint Guide and AISC M016. Unless otherwise specified, there shall be no drilling or burning of holes in the building structural steel.
- B. Unless otherwise indicated, attachments to the building concrete shall be in accordance with the requirements of SMACNA Seismic Restraint Guide.
- C. Hanger components shall not be used for purposes other than, for which they were designed. They shall not be used for rigging and erection purposes.
- D. The Contractor shall install items to be embedded before concrete is poured. Fasten embedded items securely to prevent movement when concrete is poured.
- E. Embedded anchor bolts shall be used instead of concrete inserts for support installations in areas below water surface or normally subject to submerging.
- F. The Contractor shall install thermal pipe hanger shields on insulated piping at required locations during hanger and support installation. Butt joint connections to pipe insulation shall be made at the time of insulation installation in accordance with the manufacturer's recommendations.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide rubber lined clamps for all uninsulated piping. Isolators shall be B-Line vibra clamp and cushion, Super Strut, Stoneman, "Trisolator", or approved equal.
- J. Hanger and support components in contact with plastic or FRP pipe shall be free of burrs and sharp edges.
- K. Rollers shall roll freely without binding.
- L. Finished floor beneath pipe stand and framing channel post bases shall be roughed prior to grouting. Grout between base plate and floor shall be free of voids and foreign material.
- M. Base plates shall be cut and drilled to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.
- N. Plastic or rubber end caps shall be provided at the exposed ends of all framing channels that are located up to 7 feet above the floor.
- O. Prime coat all exposed steel hangers and supports. Refer to Section 09900 for finish painting. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.



- P. Unless otherwise indicated, exposed exterior steel pipe supports, channel, and clamps shall have hot dipped galvanized finish of minimum 1.50 ounces per square foot on each side in conformance with ASTM A123.
- Q. Welds on pipe supports, either interior or exterior shall be cleaned of flux and finished with a “zinc rich” primer.
- R. The Contractor shall adjust hangers and supports to obtain required pipe slope and elevation. Shims made of material that is compatible with the piping material may be used. Stanchions shall be adjusted prior to grouting their base plates.
- S. Beam clamps shall not be installed on piping greater than 8 inches in diameter. All beam clamps shall have beam clamp retaining straps.

### **3.4 EQUIPMENT BASES AND SUPPORTS**

- A. Provide housekeeping pads of concrete, thickness as indicated on the Drawings and extending 6 inches beyond supported equipment.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

### **3.5 FLASHING**

- A. Provide flashing where indicated or necessary.
- B. Provide flexible flashing and metal counter flashing where ductwork penetrates weather or waterproofed walls, floors, and roofs.
- C. Flash vent and water pipes projecting 12 inches minimum above finished roof surface with lead flashing and cast iron counter flashing, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, seal per Drawing Details.
- D. Flash floor drains in floors with topping over finished areas with 6-lb. lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- E. Seal floor drains watertight to adjacent materials.
- F. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms installed in accordance with manufacturer's instructions for sound control.
- G. Adjust storm collars tight to pipe with bolts; calk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

### 3.6 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Extend sleeves through floors one inch above finished floor level. Calk sleeves.
- D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and calk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- E. Install chrome plated steel escutcheons at finished surfaces.

### 3.7 SUPPORT SCHEDULE

PIPE SIZE (Inches)	MAXIMUM SUPPORT SPACING (Feet)	HANGER ROD DIAMETER (Inches)
Steel (Sched. 40)		
1/2	6	3/8
3/4 to 1	8	3/8
1-1/4 to 2	10	3/8
2-1/2 to 3	10	1/2
4 to 6	14	5/8
Copper Type L		
1/2 to 3/4	5	3/8
1 to 1-1/4	6	3/8
1-1/2 to 2	8	3/8
2-1/2	9	1/2
3	10	1/2
4 to 6	12	5/8
C.I. No-Hub and at Joints		
1-1/2 to 2	8	3/8
2-1/2 to 3	8	1/2
4 to 6	8	5/8

**END OF SECTION 22 05 29**

## SECTION 22 05 30 – PIPE INSULATION FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Scope: This section specifies insulation for exposed piping and related equipment and appurtenant surfaces.

#### 1.2 QUALITY ASSURANCE

- A. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

ASTM B209	Aluminum and Aluminum-Alloy Sheet and Plate.
ASTM C533	Calcium Silicate Block and Pipe Thermal Insulation.
ASTM D1621	Compressive Properties of Rigid Cellular Plastics.
ASTM D1056	Flexible Cellular Materials.
ASTM C921	Jacketing Materials.
ASTM C533	Mineral Fiber Blanket and Felt Insulation.
ASTM C612	Mineral Fiber Block and Board Insulation.
ASTM C449	Mineral Fiber Hydraulic Setting and Finishing Cement.
ASTM C195	Mineral Fiber Thermal Insulating Cement.
ASTM C547	Mineral Fiber Preformed Pipe Insulation.
ASTM C534	Performed Flexible Elastomeric Cellular Thermal Insulation In Sheet and Tubular Form.
ASTM C518	Steady State Heat Flux Measurements.
ASTM C177	Steady State Heat Flux Measurements.
ASTM E84	Surface Burning Characteristics.
ASTM E96	Water Vapor Transmission of Materials.
ASTM D2842	Water Vapor Transmission of Rigid Cellular Plastics.
MICA	National Commercial and Industrial Insulation Standards

- B. Applicator: Company specializing in performing the work of this section with minimum three years experience.
- C. Store insulation in original wrapping and protect from weather and construction traffic.
- D. Protect insulation against dirt, water, chemical, and mechanical damage.
- E. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- F. Maintain temperature during and after installation for minimum period of 24 hours.

### **1.3 SUBMITTALS**

- A. The following information shall be provided in accordance with the following:
  - 1. Manufacturer and manufacturer's type designation.
  - 2. Samples, for each insulation material type, of typical jacket and closures for fittings, valves and appurtenances.
  - 3. Descriptive literature and catalog data for materials to be used showing methods of installation.
- B. Certification of ratings for water vapor transmission and puncture and stiffness.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Piping insulation shall be tubular or the flexible blanket type. Insulation for valves, strainers, fittings, expansion joints, flanges and other connections shall be segmented sections, molded, or blanket type coverings of the specified type and thickness of pipe insulation, or the flexible blanket type. Equipment insulation shall be flexible blanket type or rigid board type cut to fit the surface.

### **2.2 GLASS FIBER**

- A. Manufacturers: Owens-Corning Fiberglass 25 ASJ/SSL, Certainteed, Knauf or equal.
- B. Insulation: ASTM C177; rigid molded, noncombustible.
  - 1. 'K' value: ASTM C335, 0.23 at 75°F.
  - 2. Minimum Service Temperature: -20°F.
  - 3. Maximum Service Temperature: 850°F.
  - 4. Maximum Moisture Absorption: 0.2 percent by volume.
  - 5. Maximum flame spread: ASTM E84; 25.
  - 6. Maximum smoke developed: ASTM E84; 50.
- C. Vapor Barrier Jacket:
  - 1. ASTM C921, White Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
  - 2. Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.
  - 3. Secure with self sealing longitudinal laps and butt strips.
  - 4. Secure with outward clinch expanding staples and vapor barrier mastic.
- D. Tie Wire: 18 gage stainless steel with twisted ends on maximum 12-inch centers.
- E. Vapor Barrier Lap Adhesive:
  - 1. Manufacturers: Armstrong, or equal (no known equal).

2. Compatible with insulation.
- F. Insulating Cement/Mastic:
1. Manufacturers: Armstrong or equal (no known equal).
  2. ASTM C195; hydraulic setting on mineral wool.
- G. Fibrous Glass Fabric:
1. Cloth: Untreated; 9 oz/sq yd weight.
  2. Blanket: 1.0 lb/cu ft density.
- H. Indoor Vapor Barrier Finish:
1. Manufacturers: Owens-Corning or equal (no known equal).
  2. Vinyl emulsion type acrylic, compatible with insulation, white color.
- I. Outdoor Vapor Barrier Mastic:
1. Manufacturers: Armstrong or equal (no known equal).
  2. Vinyl emulsion type acrylic, compatible with insulation, white color.
- J. Insulating Cement:
1. Manufacturers: Armstrong or equal (no known equal).
  2. ASTM C449.

### **2.3 GLASS FIBER, FLEXIBLE**

- A. Manufacturers: Owens Corning, Certainteed, Knauf or equal.
- B. Insulation: ASTM C553; flexible, noncombustible.
1. 'K' value : ASTM C177, 0.24 at 75°F .
  2. Maximum service temperature: 250°F.
  3. Maximum moisture absorption: 0.2 percent by volume.
  4. Density: 2.0 lb/cu ft density.
  5. Maximum flame spread: ASTM E84; 25.
  6. Maximum smoke developed: ASTM E84; 50.
- C. Vapor Barrier Jacket:
1. ASTM C921, kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
  2. Moisture vapor transmission: ASTM E96; 0.02 perm.
  3. Secure with self sealing longitudinal laps and butt strips.
  4. Secure with outward clinch expanding staples and vapor barrier mastic.
- D. Tie Wire: 18 gage stainless steel with twisted ends on maximum 12-inch centers.
- E. Vapor Barrier Lap Adhesive:

1. Manufacturers: Armstrong or equal (no known equal).
2. Compatible with insulation.

F. Insulating Cement/Mastic:

1. Manufacturers: Armstrong or equal (no known equal).
2. ASTM C195; hydraulic setting on mineral wool.

## **2.4 GLASS FIBER, RIGID**

A. Manufacturers: Owens Corning, Certainteed, Knauf or equal.

B. Insulation: ASTM C612; rigid, noncombustible.

1. 'K' value: ASTM C177, 0.24 at 75°F.
2. Maximum service temperature: 850°F.
3. Maximum moisture absorption: 0.1 percent by volume.
4. Density: 3.0 lb/cu ft density.
5. Maximum flame spread: ASTM E84; 25.
6. Maximum smoke developed: ASTM E84; 50.

C. Vapor Barrier Jacket:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
2. Moisture vapor transmission: ASTM E96; 0.02 perm.
3. Secure with self sealing longitudinal laps and butt strips.
4. Secure with outward clinch expanding staples and vapor barrier mastic.

D. Facing: 1-inch galvanized steel hexagonal wire mesh stitched onto both faces of insulation.

E. Vapor Barrier Lap Adhesive:

1. Manufacturers: Armstrong or equal (no known equal).
2. Compatible with insulation.

F. Insulating Cement/Mastic:

1. Manufacturers: Armstrong or equal (no known equal).
2. ASTM C195; hydraulic setting on mineral wool.

## **2.5 CELLULAR FOAM**

A. Manufacturers: Armaflex, Rubatex, or equal.

B. Insulation: ASTM C534; flexible, cellular elastomeric, molded or sheet.

1. 'K' value: ASTM C177 or C518; 0.28 at 75 °F.
2. Minimum service temperature: -40 °F.
3. Maximum service temperature: 220 °F.

4. Maximum moisture absorption: ASTM D1056; 3.0 percent (pipe) by volume, 6.0 percent (sheet) by volume.
5. Moisture vapor transmission: ASTM E96; 0.20 perm inches.
6. Maximum flame spread: ASTM E84; 25.
7. Maximum smoke developed: ASTM E84; 50.
8. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive:

1. Manufacturers: Armstrong 520 or equal (no known equal).
2. Air dried, contact adhesive, compatible with insulation.

## **2.6 INSERTS**

A. Polyurethane Rigid Foam Insulation:

1. Manufacturer: Trymer 9501, Insul Therm or equal.
2. Insulation:
  - a. Minimum Service Temperature: -320°F.
  - b. Maximum Service Temperature: 300°F.
  - c. Moisture Absorption: ASTM D2842, .05 lb/ft<sup>2</sup>.
  - d. "K" value: ASTM C518; 0.14 at 75°F.
  - e. Maximum Flame Spread: ASTM E84; 20.
  - f. Maximum Smoke Density: ASTM E84; 50.
  - g. Compressive Strength: ASTM D-1621; 28 parallel, 20 perpendicular.

B. Hydrous Calcium Silicate:

1. Manufacturer: Pabco Super Caltemp or equal.
2. Insulation: ASTM C533; rigid molded white; asbestos free.
  - a. "K" value: ASTM C177 and C518; 0.40 at 300°F.
  - b. Maximum Service Temperature: 1,200°F.
  - c. Density: 14 lb/cu. ft.

## **2.7 JACKETS**

A. PVC Plastic:

1. Manufacturers for Colored PVC Jackets: Not Used.
2. Manufacturers for White PVC Jackets shall be Proto Corp. LoSMOKE 20, Ceel-Co 550, Foster's Speedline 25/50 or equal.
3. Jacket: ASTM C921, One piece molded type fitting covers and jacketing; high gloss white color unless otherwise indicated.
  - a. Minimum Service Temperature: 0°F.
  - b. Maximum Service Temperature: 150°F.

- c. Moisture Vapor Transmission: ASTM E96; 0.002 perm inches.
  - d. Maximum Flame Spread: ASTM E84; 25.
  - e. Maximum Smoke Developed: ASTM E84; 50.
  - f. Thickness: 0.020 inch.
  - g. Connections: Vapor seal mastic.
4. Covering Adhesive Mastic:
- a. Manufacturers: Manville Zeston Perma-Weld, Ceel-Co 300 or equal.
  - b. Compatible with insulation and jacket.
- B. Aluminum Jacket: ASTM B209
1. Thickness: 0.020 inch sheet.
  2. Finish: Embossed.
  3. Joining: Longitudinal slip joints and 2 inch laps.
  4. Fittings: 0.020 inch thick die shaped fitting covers with factory attached protective liner.
  5. Metal Jacket Bands: 1/2 inch wide; 0.010 inch thick aluminum.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General: Insulation shall be applied over clean, dry surfaces. Double layout insulation, where specified or required to achieve the specified surface temperature, shall be provided with staggered section joints.
- B. Pipe Supports and Shields: Unless otherwise specified, thermal pipe hanger shields shall be provided by the Contractor and installed during pipe support installation. Where thermal pipe hanger shields are used, apply the following to all butt joints:
1. On cold water, the Contractor shall apply a wet coat of vapor barrier lap cement on all butt joints and seal the joints with a minimum 3 inch wide vapor barrier tape or band.
- C. Protection: Insulation and jackets shall be protected from crushing, denting, and similar damage during construction. Vapor barriers, shall not be penetrated or otherwise damaged. Insulation, jacket, and vapor barriers damaged during construction shall be removed and new material shall be installed.
- D. Piping Insulation:
1. General:
    - a. Pipe: Piping shall be continuously insulated with Glass Fiber specified in paragraph 22 05 30-2.2, along its entire length including in-line devices such as valves, fittings, flanges, couplings, strainers, triple-duty valves and other piping appurtenances. Insulation shall be butted firmly together and jacket laps and joint strips provided with lap adhesive. Jackets shall be provided with their seams



located on the topside of pipe for pipes located at least five feet above finished floor. Pipes located below five feet above finished floor shall be provided with their seams located underneath the pipe. Removable flexible blanket-type insulation need not be jacketed. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.

- b. Fittings, Connections, Flanges and Valves: Fitting, connection, flange and valve insulation shall be insulated with Glass Fiber (Flexible or Rigid) specified in paragraph 22 05 30-2.3 and 2.4, provided with jackets specified in paragraph 22 05 30-2.7. Insulation shall be secured in place with 20-gage wire and a coat of insulating cement. Jackets shall be provided with their seams located on the underside of fittings and valves.
2. Insulated Cold Pipes Conveying Fluids Below Ambient Temperatures:
    - a. Pipe: Refer to Section 2.5.
    - b. Fittings, Connections, Flanges and Valves: Refer to Section 2.5.
  3. Insulated Pipes Conveying Fluids Above Ambient Temperature:
    - a. Pipe: Provide standard jackets, with or without vapor barrier, factory or field applied. Refer to MICA Plate No. 36.
    - b. Fittings, Flanges, and Valves: Insulation shall be covered with PVC jackets specified in paragraph 22 05 30-2.7-A. The ends of jackets shall be secured with PVC end caps (trimmed away from valve stem). Refer to MICA Plate No 12 (fittings) and No. 15 (valves). Covers shall be secured with adhesive.
    - c. For hot piping conveying fluids 140°F or less, do not insulate flanges and unions at equipment, but bevel and seal end of insulation.
    - d. For hot piping conveying fluids over 140°F, insulate flanges and unions at equipment.
  4. Outdoor Piping:
    - a. Pipe: Rigid insulation shall be provided with aluminum jackets specified in paragraph 22 05 30-2.7-B unless otherwise indicated. Flexible blanket-type insulation shall be designed for outdoor, weather-exposed service. Refer to MICA Plate No. 6.
    - b. Fittings, Connections, Flanges and Valves: Rigid insulation shall be provided with rigid aluminum covers specified in paragraph 22 05 30-2.4-B. Flexible blanket-type insulation shall be designed for outdoor, weather-exposed service. Refer to MICA Plate No. 17 (fittings) and No 14 (valves).
    - c. Provide aluminum jacket for all exterior piping.
  5. Inserts and Shields:
    - a. Inserts for piping conveying fluids below ambient temperature shall be polyurethane as specified in paragraph 22 05 30-2.6-A.
    - b. Inserts for piping conveying fluids above ambient temperature shall be polyurethane or calcium silicate as specified in paragraph 22 05 30-2.6.
    - c. Application: Piping 2" diameter or larger.
    - d. Shields: Minimum 18-gauge galvanized steel between hangers and inserts.

- e. Insert Location: Between support shield and equipment and under the finish jacket.
  - f. Insert Configuration: Minimum 6” long, of same thickness and contour as adjoining insulation; may be factory fabricated.
- 6. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.
  - 7. Install insulation for equipment requiring access for maintenance, repair, or cleaning in such a manner that it can be easily removed and replaced without damage.
- E. Mechanical Equipment Insulation:
- 1. General: Unless otherwise specified, insulation shall be Glass Fiber (Flexible and Rigid) specified in paragraph 22 05 30-2.3 and 2.4. Wrap equipment with fiberglass blanket and build box around equipment with 1-1/2" thick fiberglass board. Weld pins or stick clips with washers may be used for flat surfaces and spaced a maximum 18 inches apart. Joints shall be staggered and voids filled with insulating cement. Unless specifically specified to be un-insulated, equipment connected to insulated piping shall be insulated.
  - 2. Low Temperature Class: Insulation shall have joints, breaks, and punctures sealed in facing with fire-retardant vapor barrier adhesive reinforced with 4 inch tape. Insulation shall be provided with a layer of open-weave glass cloth embedded into a wet coat of fire-retardant adhesive. Seams shall overlap at least 2 inches. A finish coat of fire-retardant adhesive shall be provided.
- F. Flashing:
- 1. Flashing shall be provided at jacket penetrations and terminations. Clearance for flashing shall be provided between insulation system and supports.
  - 2. A heavy tack coat of sealant shall be troweled over the insulation, extending over the jacket edge 1 inch and over the pipe of protrusion 2 inches. Reinforcement shall be stretched over the tack coat after clipping to fit over pipe and jacket. Clipped reinforcing shall be strapped with a continuous band of reinforcing to prevent curling. Sealant shall be troweled over the reinforcement to a minimum thickness of 1/8 inch.
  - 3. Aluminum caps shall be formed to fit over the adjacent jacketing and to completely cover coated insulation. Cap shall be held in place with a jacket strap.

### 3.2 PIPING INSULATION

- A. The insulation dimensional tolerances shall comply with the specified standards. Unless otherwise indicated, equipment insulation shall match thickness of attached piping. The minimum insulation thickness exclusive of jacket, and insulation jacket colors shall be as follows:

Service	Piping Service Range°	1” and	1.25”	2.50”	5” and	8” and	PVC Jacket Color
		Less	to 2”	to 4”	6”	Larger	
Domestic Hot Water	105-140	0.5	1.0	1.0	-	-	N/A
Domestic HW Return	100-130	0.5	1.0	1.0	-	-	N/A
Condensate Drains	50-65	0.5	1.0	1.0	-	-	N/A

**3.3 EQUIPMENT INSULATION SCHEDULE**

A. Hot Water Heating Systems:

- |    |                 |            |
|----|-----------------|------------|
| 1. | Heat Exchangers | 1.5 inches |
| 2. | Pumps           | 1.5 inches |
| 3. | Valves          | 1.5 inches |

**END OF SECTION 22 05 30**

**P2S Inc.**  
005.2882.000

January 10, 2022  
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**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

## **SECTION 22 05 48 - VIBRATION AND SEISMIC CONTROLS 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. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Elastomeric hangers.
11. Spring hangers.
12. Snubbers.
13. Restraint channel bracings.
14. Restraint cables.
15. Seismic-restraint accessories.
16. Mechanical anchor bolts.
17. Adhesive anchor bolts.

- B. Related Requirements:

1. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 230548 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

#### **1.3 DEFINITIONS**

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

#### 1.4 ACTION SUBMITTALS

- A. Submittals shall be formatted per Section 220000 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All **exceptions** shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
1. “No Exception Taken”.
  2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. Product Data: For each type of product.
1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
  2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
    - 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 OSHPD an agency acceptable to authorities having jurisdiction.
    - b. Annotate to indicate application of each product submitted and compliance with requirements.
  3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- C. Shop Drawings:
1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.
- D. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
1. Include design calculations and details for selecting vibration isolators and 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 due to equipment weight and operation, due to seismic forces required to select vibration isolators, and due to seismic restraints.
  3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
  4. Seismic-Restraint Details:
    - a. Design Analysis: To support selection and arrangement of seismic 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 OSHPD an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control reports.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: 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 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 and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading: (Refer to structural specification)

## **2.2 ELASTOMERIC ISOLATION PADS**

- A. Elastomeric Isolation Pads:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ace Mountings Co., Inc.
  - b. California Dynamics Corporation.
  - c. Isolation Technology, Inc.
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Smooth Ribbed Waffle pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.
8. Sandwich-Core Material: Resilient and elastomeric.
  - a. Surface Pattern: Smooth Ribbed Waffle pattern.
  - b. Infused nonwoven cotton or synthetic fibers.

## **2.3 ELASTOMERIC ISOLATION MOUNTS**

- A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ace Mountings Co., Inc.
  - b. California Dynamics Corporation.
  - c. Isolation Technology, Inc.
2. Mounting Plates:
  - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
  - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## **2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS**



A. Restrained Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ace Mountings Co., Inc.
  - b. California Dynamics Corporation.
  - c. Isolation Technology, Inc.
2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
  - a. Housing: Cast-ductile iron or welded steel.
  - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## 2.5 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ace Mountings Co., Inc.
  - b. California Dynamics Corporation.
  - c. Isolation Technology, Inc.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

## 2.6 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ace Mountings Co., Inc.

- b. California Dynamics Corporation.
  - c. Isolation Technology, Inc.
- 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 6. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
    - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    - b. Top housing with attachment and leveling bolt threaded mounting holes and internal leveling device elastomeric pad.

## **2.7 RESTRAINED-SPRING ISOLATORS**

### **A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ace Mountings Co., Inc.
  - b. California Dynamics Corporation.
  - c. Isolation Technology, Inc.
- 2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
  - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
  - b. Top plate with threaded mounting holes elastomeric pad.
  - c. Internal leveling bolt that acts as blocking during installation.
- 3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
- 4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
- 5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
- 6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
- 7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## **2.8 HOUSED-RESTRAINED-SPRING ISOLATORS**

### **A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ace Mountings Co., Inc.
  - b. California Dynamics Corporation.
  - c. Isolation Technology, Inc.
2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable non-adjustable snubbers to limit vertical movement.
  - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
  - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## **2.9 PIPE-RISER RESILIENT SUPPORT**

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
  1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
  2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

## **2.10 RESILIENT PIPE GUIDES**

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.
  1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

## **2.11 ELASTOMERIC HANGERS**

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ace Mountings Co., Inc.
  - b. California Dynamics Corporation.
  - c. Isolation Technology, Inc.
2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

## **2.12 SPRING HANGERS**

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ace Mountings Co., Inc.
    - b. California Dynamics Corporation.
    - c. Kinetics Noise Control, Inc.
  2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
  3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
  8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
  9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

## **2.13 SNUBBERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Kinetics Noise Control, Inc.
  2. Mason Industries, Inc.

3. Novia; A Division of C&P.
- B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
  2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
  3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.

## **2.14 RESTRAINT CHANNEL BRACINGS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business.
  2. Hilti, Inc.
  3. Mason Industries, Inc.
- B. 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 and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

## **2.15 RESTRAINT CABLES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CADDY; a brand of nVent.
  2. Gripple Inc.
  3. Kinetics Noise Control, Inc.
- B. Restraint Cables: ASTM A603 galvanized ASTM A492 stainless-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.

## **2.16 SEISMIC-RESTRAINT ACCESSORIES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business.
  2. CADDY; a brand of nVent.
  3. TOLCO.

- B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections Reinforcing steel angle clamped to hanger rod.
- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- D. 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.
- E. 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.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

#### **2.17 MECHANICAL ANCHOR BOLTS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. B-line, an Eaton business.
  - 2. Hilti, Inc.
  - 3. Mason Industries, Inc.
- B. 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.

#### **2.18 ADHESIVE ANCHOR BOLTS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Hilti, Inc.
  - 2. Kinetics Noise Control, Inc.
  - 3. Mason Industries, Inc.
- B. 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 of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 APPLICATIONS**

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction.
- 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 due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

### **3.3 VIBRATION CONTROL AND 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 033000 "Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- D. Equipment Restraints:
  - 1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
  - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
  - 3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- E. Piping Restraints:

1. Comply with requirements in MSS SP-127.
  2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
  3. Brace a change of direction longer than 12 feet.
- F. Install cables so they do not bend across edges of adjacent equipment or building structure.
- G. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- I. 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.
- J. 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.
- K. 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 piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 221116 "Domestic Water Piping" for piping flexible connections.



### 3.5 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. 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.
  - 6. Measure isolator restraint clearance.
  - 7. Measure isolator deflection.
  - 8. Verify snubber minimum clearances.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

### 3.6 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

**END OF SECTION 22 05 48**

**P2S Inc.**  
005.2882.000

January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

## SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING & EQUIPMENT

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Scope: This section specifies plumbing identification for equipment and piping systems specified in Division 22. The following are included: nameplates, tags, stencils and pipe markers.

#### 1.2 QUALITY ASSURANCE

- A. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

ANSI A13.1      Scheme for the Identification of Piping Systems.  
MIL-STD-810C    Environmental Test Methods.

#### 1.3 SUBMITTALS

- A. Submit the following under provisions of paragraph 22 05 00-1.1.
1. Submit list of wording, symbols, letter size, and color coding for plumbing identification.
  2. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
  3. Product Data: Provide manufacturers catalog literature for each product required.

#### 1.4 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 017836.
- B. Record actual locations of tagged valves on Record Drawings.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Seton Name Plate Company, Inc.
- B. Marking Services, Inc.

- C. WH Brady Company.
- D. Or equal

## **2.2 NAMEPLATES**

- A. Description: Laminated three-layer plastic with engraved white letters on black background color.

## **2.3 TAGS**

- A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- B. Chart: Typewritten letter size list in anodized aluminum frame.

## **2.4 STENCILS**

- A. Stencils: With clean cut symbols and letters of following size:

3/4 to 1-1/4 inch O.D. of Insulation or Pipe:	8 inch long color field, 1/2 inch high letters.
1-1/2 to 2 inch O.D. of Insulation or Pipe:	8 inch long color field, 3/4 inch high letters.
2-1/2 to 6 inch O.D. of Insulation or Pipe:	12 inch long color field, 1-1/4 inch high letters.
Equipment:	2-1/2 inch high letters.
- B. Stencil Paint: Semi- gloss enamel, colors conforming to ANSI A13.1 unless otherwise specified.

## **2.5 PIPE MARKERS**

- A. Plastic markers for coding pipe shall conform to ANSI A13.1. Markers shall be the mechanically attached type that are easily removable and firmly attached; they shall not be the adhesive applied type. Markers shall consist of pressure sensitive legends applied to plastic backing which is strapped or otherwise mechanically attached to the pipe. Legend and backing shall be resistant to petroleum based oils and grease and shall meet criteria for humidity, solar radiation, rain, salt, fog and leakage fungus, as specified by MIL-STD-810C. Markers shall withstand a continuous operating temperature range of -40°F to 180°F. Plastic coding markers shall not be the individual letter type but shall be manufactured and applied in one continuous length of plastic.
- B. Markers bearing the legends on the background colors specified in ANSI A13.1 shall be provided in the following letter heights:

Outside Pipe Diameter*, Inches	Letter Height, Inches
Less than 1-1/2	1/2
1-1/2 through 3	1-1/8

\*Outside pipe diameter shall include insulation and jacketing

In addition, pipe markers shall include uni- and bi- directional arrows in the same sizes as the legend. Legends and arrows shall be white on blue or red backgrounds and black on other specified backgrounds.

- C. Tracer tape shall be 6 inches wide, colored the same as the background colors as specified in ANSI A13.1, and made of inert plastic material suitable for direct burial. Tape shall be capable of stretching to twice its original length.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 099100 for stencil painting.

#### **3.2 INSTALLATION**

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Section 099100.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Identify plumbing equipment with plastic nameplates. Small devices, such as a control valve, may be identified with tags.
- G. Identify control panels and major control components outside panels with plastic nameplates.
- H. Identify valves in main and branch piping with tags.
- I. Identify piping, concealed or exposed with plastic pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including

risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

**END OF SECTION 22 05 53**

## SECTION 22 08 00 - COMMISSIONING OF PLUMBING

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

##### A. Commissioning

1. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the owner's project requirements and operational needs. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing adjusting and balancing, performance testing and training. Commissioning during the construction phase is intended to achieve the following specific objectives:
  - a. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
  - b. Verify and document proper functional performance of equipment and systems.
  - c. Verify that O&M documentation left on site is complete.
  - d. Verify that the Owner's operating personnel are adequately trained.

##### B. Facility Grid

1. The CxA utilizes, Facility Grid, cloud-based and mobile commissioning software platform to execute commissioning activities and deliverables. <https://facilitygrid.com/> CxA will provide project team members introduction to Facility Grid's platform.
2. Facility Grid will allow CxA, facility managers, architects, contractors, maintenance personnel, and corporate administrators can actually see and operate in the same loop real time. This transparency opens the door to major short and long-term efficiencies in all phases of the facilities management process.
3. Facility Grid defines the future of commissioning software by increasing the efficiency of commissioning agents, by streamlining commissioning projects and record keeping, by enabling project managers to see the big and small pictures in real time, across all projects, and by providing owners with a database of building information to benefit from today and in the future.
  - a. Real-Time Collaboration
  - b. Transparency
  - c. Team Engagement
  - d. Accountability
  - e. Information Sustainability

#### 1.2 RELATED WORK

##### A. Division 01 – General Requirements

### COMMISSIONING OF PLUMBING

1. Section 013300 – Submittal Procedures
2. Section 017700 – Closeout Procedures
3. Section 019113 – General Commissioning Requirements

### 1.3        **ABBREVIATIONS AND DEFINITION**

- A.    A/E: Design Professional
- B.    ASI: Architectural Supplemental Instruction
- C.    BAS: Building Automation System
- D.    BoD: Basis of Design. A narrative of how the designer plans to achieve the OPR.
- E.    CxA: Commissioning Authority
- F.    CC: Controls Contractor
- G.    CM: Construction Manager
- H.    Cx: Commissioning
- I.    Cx Plan: Commissioning Plan
- J.    Cx RFI: Commissioning Request for Information
- K.    DDC: Direct Digital Control System
- L.    Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents and cannot be corrected in five (5) minutes time.
- M.    EC: Electrical Contractor
- N.    FBO: Furnished By Others
- O.    FT: Functional Performance Test
- P.    GC: General Contractor
- Q.    IAW: In Accordance With
- R.    MC: Mechanical Contractor
- S.    O&M: Operation and Maintenance
- T.    OPM: Owner Project Manager
- U.    OPR: Owner Project Requirement. A dynamic document expressing how the owner expects the building systems to perform upon project completion.



- V. PC: Prefunctional Checklist
- W. RFI: Request for Information
- X. Sub(s): Subcontractors or Prime Contractor
- Y. TAB: Test, Adjust and Balance
- Z. TBD: To Be Determined

#### **1.4 PLUMBING EQUIPMENT AND SYSTEMS TO BE COMMISSIONED**

- A. The specific systems that shall be commissioned include:
- B. Plumbing Systems (and all integral equipment controls)
  - 1. Domestic Potable Water Meter
  - 2. Electric Instantaneous Water Heater

#### **1.5 SUBMITTALS**

- A. Refer also to Specification Section 019113, Subsection 1.6.
- B. Provide the CxA a copy of the following items, for the systems to be commissioned:
  - 1. Equipment and System Submittals to include, at minimum, the following:
  - 2. Equipment Data Sheets
  - 3. Performance data
  - 4. Manufacturer's pre-startup checklists
  - 5. Manufacturer's start-up checklists
  - 6. Installation Instructions
  - 7. Shop drawings (including any resubmittals required by the A/E)
  - 8. Piping - Supply one copy of all of hydrostatic pressure test results
  - 9. Operational and maintenance documentation
  - 10. Training plan and training materials
  - 11. As-built documentation

### **PART 2 - PRODUCTS**

#### **2.1 TEST EQUIPMENT**

- A. Refer to Specification Section 019113, Subsection 2.1.

### **PART 3 - EXECUTION**

### **3.1 MEETINGS**

- A. Refer to Specification Section 019113, Subsection 3.3.

### **3.2 START-UP, PREFUNCTIONAL CHECKLISTS, AND INITIAL CHECKOUT**

- A. The following procedures apply to all equipment to be commissioned, according to Subsection 1.4 above.

- B. General

- 1. Prefunctional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.

- C. Start-up and Initial Checkout Plan

- 1. The CxA will provide prefunctional checklists (PFCs). PFCs indicate the required procedures to be executed as part of startup and initial checkout of the systems.
- 2. The subcontractor responsible for providing and installing the equipment develops the full start-up plan by combining (or adding to) the CxA's prefunctional checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
- 3. The full start-up plan shall consist of:
- 4. The CxA's prefunctional checklists.
  - a. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end
  - b. The manufacturer's normally used field checkout sheets
  - c. The contractor submits the full startup plan to the CxA for review and approval.
- 5. The CxA reviews and approves the procedures and the format for documenting them, noting any plans that need to be added.

- D. Execution of Prefunctional Checklists and Startup

- 1. Two weeks prior to startup, the Subs and vendors schedule startup and checkout with the CM, GC and CxA. The performance of the prefunctional checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off prefunctional checklists, signatures may be required of other Subs for verification of completion of their work.
- 2. The CxA will observe the physical start-up of all major systems.
- 3. The CxA will verify piping cleanout procedures and verify any required water or lab tests.

4. The Subs and vendors shall execute startup and provide the GC with a signed and dated copy of the completed start-up and prefunctional tests and checklists. The GC reviews for completion and accuracy, then submits to the CxA.
5. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.
6. Completed startup test report must be provided to CxA prior to functional testing.

E. Deficiencies, Non-Conformance and Approval in Checklists and Startup

1. The Subs shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully. The procedures form and any outstanding deficiencies shall be provided to the CxA within two days of test completion.
2. The CxA will work with the Subs and vendors to determine what is required to correct outstanding deficiencies and retest deficiencies of uncompleted items. The CxA will involve the CM, GC and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CxA as soon as outstanding items have been corrected.
3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in back charges to the responsible party. Refer to Specification Section 019113, Subsection 3.6 – DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS.

### 3.3 FUNCTIONAL PERFORMANCE TESTING

- A. This subsection applies to functional testing and demonstration for equipment and system in this division.
- B. The general list of equipment and systems to be commissioned is found in Subsection 1.04.
- C. Objectives and Scope
  1. The objective of functional performance testing is to demonstrate that each system is operating according to the owner's project requirements, documented project program, and Contract Documents. Functional testing facilitates bringing the systems from a state of material completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and function of the systems.
  2. In general, each system shall be operated through all modes of operation where there is a specified system response.
  3. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.
  4. The contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, tools, instruments, ladders, lifts, computers, software, cables, etc. Contractor supplied personnel must be competent with and knowledgeable of all project-specific systems, and automation hardware and software. All training documentation, submittals, installation manuals, and O&Ms, shall be at the job site before functional testing commences.

D. Development of Test Procedures

1. The CxA develops specific functional test procedures and forms to verify and document proper operation of each piece of equipment and system. The CxA provides a copy of the test procedures to the A/E, CM and installing Sub who shall review the tests prior to testing. The A/E and Sub(s) shall point out to the CxA any specific problems as related to feasibility, safety, equipment and warranty protection.

E. Coordination and Scheduling

1. The GC shall provide sufficient notice to the CxA regarding the Subs completion schedule for the prefunctional checklists and startup of all equipment and systems. The CxA will schedule functional tests after written notification from the GC and affected Subs. Completed startup testing report must be provided to CxA prior to functional testing. The CxA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.
2. In general, functional testing shall not be scheduled until all hardware and software submittals are approved, Prefunctional checklists are approved, and start-up has been satisfactorily completed. Scheduling of functional testing shall be done with a minimum of two weeks' notice prior to testing. Functional testing of the equipment and systems listed in Subsection 1.04 of this specification section shall not be conducted out of the presence of the CxA and CM, unless specifically approved to do so in writing by the CxA or CM. Any functional testing which occurs outside the presence of the CxA or CM without written authorization to do so will be required to be re-tested at no expense to the owner.

F. Test Methods

1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone data loggers.

G. Demonstration, Verification, and Validation

1. The plumbing systems demonstration shall include, at minimum, the following:
  - a. Domestic Potable Water Meter
  - b. Electric Instantaneous Water Heater

H. Problem Solving

1. The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the GC, Subs and A/E.

### 3.4 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

- A. Refer to Specification Section 019113, Subsection 3.6.

### **3.5 OPERATION AND MAINTENANCE MANUALS**

- A. In addition to installation manuals, the contractor shall provide one copy of the Operation and Maintenance Manuals to the CxA for the systems to be commissioned. The O&M Manuals shall be provided to the CxA at least 8 weeks prior to the start of Functional Testing.

### **3.6 TRAINING OF OWNER PERSONNEL**

See Specification Section 019113, Subsection 3.8.

- A. Provide designated Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of plumbing equipment or system.
- B. CxA shall attend a sample of the training sessions and validate that the training has occurred according to the specifications.

### **3.7 DEFERRED TESTING**

- A. See Specification Section 019113, Subsection 3.9.

**APPENDIX A**

**EXAMPLE PREFUNCTIONAL CHECKLIST**

**System Name: Electric Instantaneous Water Heater - x (WH-x)**

**Serves: Building x**

**Prefunctional Checklist**

**1. Verification**

Pre-functional checklist items must be completed as part of startup & initial checkout, in preparation for Functional Performance Testing. The following items are complete and the system is ready for Functional Performance Testing:

- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable).
- The prefunctional checklist items are complete and have been signed off only by parties having direct knowledge of the event.
- Contractor’s assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- “Contr.” column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item.
- This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items.
- The installation is complete and ready for functional testing.

A/E	Architect/Engineer	All	All Contractors	EC	Electrical Contractor
CxA	Commissioning Agent	CC	Controls (BAS) Contractor	GC	General Contractor
MC	Mechanical Contractor	TAB	TAB Contractor	PC	Plumbing Contractor

<i>Signature:</i>	<i>Signature:</i>	<i>Signature:</i>
_____	_____	_____
Date:	Date:	Date:
_____	_____	_____
Name:	Name:	Name:
_____	_____	_____
GC: General Contractor Company	PC: Plumbing Contractor Company	EC: Electrical Contractor Company

<i>Signature:</i>	<i>Signature:</i>	<i>Signature:</i>
_____	_____	_____
Date:	Date:	Date:
_____	_____	_____
Name:	Name:	Name:
_____	_____	_____
Owner: Owner Representative Company		

**2. Approvals**

This prefunctional checklist has been completed and is approved with the exceptions noted below.

*Signature:*

\_\_\_\_\_

Date:

\_\_\_\_\_

Name:

\_\_\_\_\_

CxA: Commissioning Authority Company

### 3. Equipment Verification

Enter N/A if not applicable. Enter note or # if deficient. Attach notes to this sheet.

Equipment Specifications	As Specified	As Submitted	As Installed	Notes
Manufacturer	Chronomite	Chronomite		
Model Number	SR-20L	SR-20L		
Serial Number	N/A	N/A		
Unit Type	Instantaneous	Instantaneous		
Capacity (Watts)	2,400	2,400		
Electrical (Volts/Phase/Hz)	120/1/60	120/1/60		

### 4. Installation Checks

Enter N/A if not applicable. Enter note or # if deficient. Attach notes to this sheet.

General Installation	Contractor	Check or Note or #
Unit is free of physical damage	PC	
Permanent identification (labels) affixed and visible	PC	
Unit installed as required by manufacturer and construction documents	PC	
Access acceptable for future maintenance of unit and components	PC	
Unit is clean, free of debris	PC	
Valves, Piping Installation	Contractor	Check or Note or #
Piping components installed in correct order as required by drawing details	PC	
Piping installed and arranged for ease of unit and components maintenance	PC	
Piping is flushed, free of debris and air	PC	
Thermal insulation installed per construction documents and no damage	PC	
Dielectric piping connections properly installed	PC	
Verify lavatory faucet aerator has maximum flow rate of 0.5 GPM	PC	
Electrical Installation	Contractor	Check or Note or #
All electrical connections are tight and code compliant	EC	
All electrical connections are grounded per drawings	EC	
Local disconnect switch is operational	EC	
Breaker/disconnect(s) labeled as to the circuit and equipment served	EC	
Control wiring and devices installed; complete	EC	

### 5. Operational Checks

Enter N/A if not applicable. Enter note or # if deficient. Attach notes to this sheet.





**APPENDIX B**

**EXAMPLE FUNCTIONAL TEST PROCEDURE**

## Functional Performance Test

### 1. System Description

This domestic hot water system consists of a lavatory faucet and instantaneous hot water heater. The domestic hot water system operates in occupied and unoccupied modes. In occupied mode, the domestic hot water heater energizes producing hot water when the lavatory hot water valve is opened allowing water to flow at a minimum flow rate of 0.35 gallons/minutes. In the event that the lavatory faucet does not have an aerator allowing a maximum water flow rate of 0.50 gallons/minute the supplied hot water temperature will become cooler than the desired setpoint of 115 degrees F. In unoccupied mode, the domestic hot water heater de-energizes when the lavatory hot water valve is closed.

- **Building:** Building x
- **System:** Instantaneous Water Heater
- **Equipment Identification:** WH-x
- **Make:** Chronomite
- **Model:** \_\_\_\_\_
- **Serial:** \_\_\_\_\_
- **Equipment Location:** Janitor Closet xxx
- **Serves:** Janitor Closet xxx

### 2. Test Participants

Organization		Participation Capacity
General Contractor	General Contractor Company	Provide assistance as needed for corrective items. Verify that items are completed, keep track of schedule.
Plumbing Contractor	Plumbing Contractor Company	Provide testing support and NIST certified instrumentation for checks outlined herein.
Owner's O&M Personnel	Owner Representative Company	<i>Optional</i>
Commissioning Authority	Commissioning Authority Company	Along with the controls contractor, perform the functional performance testing as Independent third party witness and documenting functional performance results.

### 3. Approvals

We the undersigned participated in this functional test, acknowledge that the functional testing process for the equipment has been completed and that noted deficiencies or corrective actions noted have been made.

<i>Signature:</i>	<i>Signature:</i>	<i>Signature:</i>
Date:	Date:	Date:
<i>Name:</i>	<i>Name:</i>	<i>Name:</i>
GC: General Contractor Company	PC: Plumbing Contractor Company	EC: Electrical Contractor Company
<i>Signature:</i>	<i>Signature:</i>	<i>Signature:</i>
Date:	Date:	Date:
<i>Name:</i>	<i>Name:</i>	<i>Name:</i>
Owner: Owner Rep. Company	CxA: Commissioning Authority Co.	

#### 4. Test Prerequisites

General Contractor to verify following items have been completed and system is ready for functional testing:

- Site checks of the prefunctional checklist and manufacturer startup reports completed successfully.
- A/E deficiency items for this equipment are completed
- Functional Performance Test procedures have been reviewed and approved by installing contractors
- Safety controls and operating ranges are set, activated and checked

Initial Test		Start Date	End Date	Initials
Results (check one) <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Partial Test w/ Corrective Actions <input type="checkbox"/> Complete Test w/ Corrective Actions <input type="checkbox"/> Other	Explanation:			

Re-Test 1		Start Date	End Date	Initials
Results (check one) <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Partial Test w/ Corrective Actions <input type="checkbox"/> Complete Test w/ Corrective Actions <input type="checkbox"/> Other	Explanation:			

Re-Test 2		Start Date	End Date	Initials
Results (check one) <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Partial Test w/ Corrective Actions <input type="checkbox"/> Complete Test w/ Corrective Actions <input type="checkbox"/> Other	Explanation:			

#### 5. Setpoint Verification

Record setpoint

Point Description	Setpoint		Note #
	Design (°F)	Actual	
Domestic Hot Water Supply Temperature	115 (+/- 5)		

#### 6. Functional Testing Procedures

The Commissioning Authority will make and document any changes, additions or deletions to this test procedure required by current system conditions (i.e. weather, system load, utility availability, etc.)

Y = Checked and Passed

R = Retest (check if retest required)

N = Not Passed

C = Corrected (check if correction verified)

Line	Mode ID	Action	Expected Response	Y	N	Comments	R	C
1	Water Heater	Hot water heater is controlled	Verify by visual inspection					

	Operation	based on the demand for potable hot water by opening or closing the lavatory faucet. (Design for heater to supply hot water at 115 +/-5°F.)	that -					
		Increase load on the water heater by "opening" hot water valve on the faucet.	Hot water heater "energizes" as the water flow rate increases beyond 0.35 GPM.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
		Record hot water temperature:	_____ (115) deg F					
		"Close" hot water valve on the faucet.	Hot water heater "de-energizes" as the water flow rate decreases below 0.35 GPM.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
		Record the cold water temperature by "opening" cold water valve on faucet.						
		Record cold water temperature:	_____ deg F					
Record issues:						Issue log item #:		

**7. Notes:**

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\* Attach additional sheets if needed.

Note: Items of non-compliance to the test requirements will be noted on the Master Commissioning Deficiency Log. The deficiency log will contain information such as date found, equipment/system involved, potential cause, responsibility and potential remedial actions. The contractor/supplier is expected to use their collective expertise to solve the problem(s) or replace defective equipment.

-- END OF TEST --

**END OF SECTION 22 08 00**

**Integrated Commissioning Solutions**  
005.2882.000

January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

## SECTION 22 11 16 - DOMESTIC WATER PIPE AND FITTINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes domestic water piping from locations indicated to fixtures and equipment inside the building.

#### 1.2 SUBMITTALS

- A. Water Samples: Specified in "Cleaning" Article in Part 3.
- B. Field quality-control test reports.

#### 1.3 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.

### PART 2 - PRODUCTS

#### 2.1 PIPING MATERIALS

- A. Transition Couplings: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

#### 2.2 COPPER PIPE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Types K and L, water tube, annealed temper.
  - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
  - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- B. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

### 2.3 VALVES

- A. Refer to Section 22 05 23 "General Duty Valves for Plumbing Piping" of Specification for plumbing general-duty valves.
- B. Refer to Section 22 13 19 "Plumbing Specialties" for balancing and drain valves.

### 2.4 WATER METERS

- A. Displacement-Type Water Meters:
  1. Manufacturers:
    - a. George Fisher
    - b. ABB.
    - c. Mueller Co.
    - d. Sensus.
    - e. Or equal
  2. Standard: AWWA C700.
  3. Pressure Rating: 150-psig working pressure.
  4. Body Design: Nutating disc; totalization meter.
  5. Registration: In gallons or cubic feet as required by utility company.
  6. Case: Bronze.
  7. End Connections: Threaded.
  8. Connectivity: Coordinate with Controls contractor for Interlocking to the Building Management System (BMS). Coordinate with Electrical contractor for the location of the spare conduit from the meter location to the nearest Automated Logic Controller (ACL).

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.
- C. Domestic Water Piping on Service Side of Water Meter inside the Building:



1. NPS 4 to NPS 6: hard copper tube and fittings, Type L, with soldered joints.
- D. Under-Building-Slab, Domestic Water Piping on House Side of Water Meter, NPS 4 and Smaller: Hard copper tube and fittings, Type K with brazed joints.
- E. Aboveground Domestic Water Piping:
1. NPS 1 and Smaller: Hard copper tube and fittings, Type L, with soldered hard copper tube and fittings joints.
  2. NPS 1-1/4 and NPS 1-1/2: Hard copper tube and fittings, Type L, with soldered hard copper tube and fittings joints.
  3. NPS 2: Hard copper tube and fittings, Type L, with soldered hard copper tube and fittings.
  4. NPS 2-1/2 to NPS 3-1/2: Hard copper tube and fittings, Type L, with soldered hard copper tube and fittings.
  5. NPS 4 to NPS 6: hard copper tube and fittings, Type L, with soldered hard copper tube and fittings.
- F. Non-potable-Water Piping: Same as for potable water:

### **3.2 VALVE APPLICATIONS**

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use bronze ball or gate valves for piping NPS 2 and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 and larger.
  2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
  3. Hot-Water-Piping, Balancing Duty: Memory-stop balancing valves.
  4. Drain Duty: Hose-end drain valves.

### **3.3 PIPING INSTALLATION**

- A. Comply with manufacturer's product data, including product technical bulletins, installation instructions, design drawings and installation guide.
- B. Refer to Division 33 for site water distribution and service piping.
- C. Refer to section of specifications "Basic Mechanical Materials and Methods" for basic piping installation.
- D. Extend domestic water service piping to exterior water distribution piping in sizes and locations indicated.
- E. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight.

- F. Install shutoff valve outside of building in concrete yardbox with cast iron cover at each domestic water service.
- G. Install domestic water piping level without pitch and plumb.
- H. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- I. Perform the following steps 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. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
  - 5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
  - 6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and that cartridges are clean and ready for use.
- J. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
- K. Check plumbing specialties and verify proper settings, adjustments, and operation.
  - 1. Water-Pressure Regulators: Set outlet pressure at 80 psig maximum, unless otherwise indicated.
- L. Energize pumps and verify proper operation.

### **3.4 JOINT CONSTRUCTION**

- A. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

### **3.5 VALVE INSTALLATION**

- A. Install sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- B. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
  - 1. Install hose-end drain valves at low points in water mains, risers, and branches.

2. Install stop-and-waste drain valves where indicated.
- D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Refer to Section "Plumbing Specialties" of the specification for calibrated balancing valves.

### 3.6 HANGER AND SUPPORT INSTALLATION

- A. Refer to Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following: 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers
- B. Install supports according to section of specifications 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.

### 3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow 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 service piping with shutoff valve, and extend and connect to the following:
  1. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Div. 22 Section "Plumbing Fixtures 22 40 00."
  3. 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 FIELD QUALITY CONTROL

- A. Inspect domestic water piping as follows:
  1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

2. 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:
  - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

**B. Test domestic water piping 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 domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. 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 to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
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.

### **3.9 CLEANING**

**A. Clean and disinfect potable domestic water piping as follows:**

1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
  - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
  - b. Fill and isolate system according to either of the following:
    - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
    - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

- c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
  - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

**END OF SECTION 22 11 16**

**P2S Inc.**  
005.2882.000

January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

## SECTION 22 11 19 - 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. Hose bibbs.
2. Water-hammer arresters.
3. Trap-seal primer valves.
4. Trap-seal primer systems.
5. Flexible connectors.
6. Water meters.

- B. Related Requirements:

1. Section 220519 "Meters and Gauges for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 224300 "Medical Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.
4. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
5. Section 224713 "Drinking Fountains" for water filters for water coolers.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall be formatted per Section 220000 "General Plumbing Requirements". The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All **exceptions** shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:

1. "No Exception Taken".
2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.

- B. Product Data: For each type of product.

- C. 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 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES**

- A. Potable-water piping and components shall comply with NSF 61 and NSF 14. Mark "NSF-pw" on plastic piping components.
- B. Comply with NSF 372 for low lead.

#### **2.2 PERFORMANCE REQUIREMENTS**

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

#### **2.3 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, 0.033 or 0.062 inch.
    - b. Strainers NPS 2-1/2 to NPS 4: 0.045, 0.062 or 0.125 inch.
    - c. Strainers NPS 5 and Larger: 0.10, 0.125 or 0.25 inch.
  - 6. Drain: Pipe plug and Factory-installed, hose-end drain valve.



## **2.4 HOSE BIBBS**

### **A. Hose Bibbs:**

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. Jay R. Smith Mfg. Co.
  - b. MIFAB, Inc.
  - c. Acorn Manufacturing
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Service Areas: Rough bronze, Chrome or nickel plated.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Operation for Service Areas: Wheel handle or Operating key.
14. Operation for Finished Rooms: Wheel handle or Operating key.
15. Include operating key with each operating-key hose bibb.
16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

## **2.5 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. MIFAB, Inc.
  - b. Precision Plumbing Products.
  - c. WATTS.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

## **2.6 TRAP-SEAL PRIMER DEVICE**

### **A. Supply-Type, Trap-Seal Primer Device:**

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. Jay R. Smith Mfg. Co.
  - b. MIFAB, Inc.
  - c. Precision Plumbing Products.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

**B. Drainage-Type, Trap-Seal Primer Device:**

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. Jay R. Smith Mfg. Co.
2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
3. Size: NPS 1-1/4 minimum.
4. Material: Chrome-plated, cast brass.

**2.7 TRAP-SEAL PRIMER SYSTEMS**

**A. Trap-Seal Primer 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. Precision Plumbing Products.
  - b. Zurn Industries, LLC.
2. Standard: ASSE 1044.
3. Piping: NPS 3/4, ASTM B88, Type L; copper, water tubing.
4. Cabinet: Recessed or Surface-mounted steel box with stainless-steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
  - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Vacuum Breaker: ASSE 1001.

7. Number Outlets: Refer to Plumbing design drawings.
8. Size Outlets: NPS 1/2 or NPS 5/8.

## **2.8 FLEXIBLE CONNECTORS**

- 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. Flex-Hose Co., Inc.
  2. Flex-Weld, Inc.
  3. Metraflex Company (The).
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
  1. Working-Pressure Rating: Minimum 200 psig or 250 psig.
  2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
  3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
  1. Working-Pressure Rating: Minimum 200 psig or 250 psig.
  2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
  3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

## **2.9 WATER METERS**

- A. Displacement-Type Water Meters:
  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. AALIANT.
    - b. ABB.
    - c. Mueller Co.
    - d. Sensus.
  2. Standard: AWWA C700.
  3. Pressure Rating: 150-psig working pressure.
  4. Body Design: Nutating disc; totalization meter.
  5. Registration: In gallons or cubic feet as required by utility company.
  6. Case: Bronze.
  7. End Connections: Threaded.
- B. Turbine-Type Water Meters:

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. Badger Industries, Inc.
    - b. Master Meter, Inc.
    - c. Sensus.
  2. Standard: AWWA C701.
  3. Pressure Rating: 150 psig working pressure.
  4. Body Design: Turbine; totalization meter.
  5. Registration: In gallons or cubic feet as required by utility company.
  6. Case: Bronze.
  7. End Connections for Meters NPS 2 and Smaller: Threaded.
  8. End Connections for Meters NPS 2-1/2 and Larger: Flanged.
- C. Compound-Type Water Meters:
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. Badger Industries, Inc.
    - b. Mueller Co.
    - c. Sensus.
  2. Standard: AWWA C702.
  3. Pressure Rating: 150-psig working pressure.
  4. Body Design: With integral mainline and bypass meters; totalization meter.
  5. Registration: In gallons or cubic feet as required by utility company.
  6. Case: Bronze.
  7. Pipe Connections: Flanged.
- D. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Backflow Preventers: 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. Water Regulators: Install with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- C. Y-Pattern Strainers: For water, install on supply side of each control valve, water pressure-reducing valve, solenoid valve and/or pump.
- D. Water-Hammer Arresters: Install in water piping according to PDI-WH 201.
- E. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- F. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- G. Trap-Seal Primer Systems: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

### **3.2 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.
- C. Comply with requirements for grounding equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

### **3.3 IDENTIFICATION**

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  1. Reduced-pressure-principle backflow preventers.
  2. Supply-type, trap-seal primer valves.
  3. Trap-seal primer systems.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### **3.4 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check, backflow-prevention assembly and/or double-check, detector-assembly 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 22 11 19**

## SECTION 22 13 16 - 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. Hubless, cast-iron soil pipe and fittings.
  - 2. Copper tube and fittings.
  - 3. Specialty pipe fittings.
  - 4. Encasement for underground metal piping.
- B. Related Requirements:
  - 1. Section 221313 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall be formatted per Section 220000 "General Plumbing Requirements". The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All **exceptions** shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
  - 1. "No Exception Taken".
  - 2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. Product Data: For each type of product.
- C. Sustainable Design Submittals:
  - 1. Product Data: For adhesives, indicating VOC content.
  - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- D. Shop Drawings: For hubless, single-stack drainage system include plans, elevations, sections, and details.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
  - 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

#### **1.5 FIELD CONDITIONS**

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify Architect, Construction Manager and Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
  - 2. Do not proceed with interruption of sanitary waste service without Architect's, Construction Manager's and Owner's written permission.

#### **1.6 WARRANTY**

- A. Listed manufacturers to provide labelling and warranty of their respective products.

### **PART 2 - PRODUCTS**

#### **2.1 PERFORMANCE REQUIREMENTS**

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
  - 2. Waste, Force-Main Piping: 50 psig, 100 psig or 150 psig.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

#### **2.2 PIPING MATERIALS**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.



### **2.3 HUBLESS, CAST-IRON SOIL PIPE 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. AB & I Foundry; a part of the McWane family of companies.
  - 2. Charlotte Pipe and Foundry Company.
  - 3. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings: ASTM A888 or CISPI 301.
- C. 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. Charlotte Pipe and Foundry Company.
    - c. Tyler Pipe; a subsidiary of McWane Inc.
  - 2. Standards: ASTM C1277 and CISPI 310.
  - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.
- D. 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. Charlotte Pipe and Foundry Company.
    - c. Tyler Pipe; a subsidiary of McWane Inc.
  - 2. Standards: ASTM C1277 and ASTM C1540.
  - 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

### **2.4 COPPER TUBE AND FITTINGS**

- A. Copper Type DWV Tube: ASTM B306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Hard Copper Tube: ASTM B88, Type L and Type M, water tube, drawn temper.
- D. Copper Pressure Fittings:

1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- E. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
  2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- F. Solder: ASTM B32, lead free with ASTM B813, water-flushable flux.

## **2.5 SPECIALTY PIPE FITTINGS**

- A. Transition Couplings:
1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
  2. 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, LLC; a division of MCP Industries.
    - b. Standard: ASTM C1460.
    - 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.
    - d. End Connections: Same size as and compatible with pipes to be joined.

## **2.6 ENCASUREMENT FOR UNDERGROUND METAL PIPING**

- A. Standard: ASTM A674 or AWWA C105/A 21.5.
- B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Natural.

## **PART 3 - EXECUTION**

### **3.1 EARTH MOVING**

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

### **3.2 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
  - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
  - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Provided seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. All cleanouts shall be installed where readily accessible. The contractor shall coordinate all cleanout locations with equipment, cabinets, etc. and architect prior to any installation.
- L. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
  - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
  - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.

- a. Straight tees, elbows, and crosses may be used on vent lines.
3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
  - a. Reducing size of waste piping in direction of flow is prohibited.
- M. Lay buried building waste piping beginning at low point of each system.
  1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
  2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  3. Maintain swab in piping and pull past each joint as completed.
- N. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
  1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 or 2 percent downward in direction of flow for piping NPS 4 and larger.
  2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
  3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- O. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
  1. Install encasement on underground piping according to ASTM A674 or AWWA C105/A 21.5.
- P. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- Q. Install engineered soil and waste and vent piping systems as follows:
  1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
  2. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 and hubless, single-stack aerator fitting manufacturer's written installation instructions.
  3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- R. Plumbing Specialties:
  1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
    - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
    - b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
  2. Install drains in sanitary waste gravity-flow piping.

- a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- T. Install sleeves for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs.
  - 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### **3.3 JOINT CONSTRUCTION**

- A. 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.
- B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
  - 1. Cut threads full and clean using sharp dies.
  - 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
    - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
    - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
    - c. Do not use pipe sections that have cracked or open welds.
- C. Join copper tube and fittings with soldered joints according to ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.
- D. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- E. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

### **3.4 SPECIALTY PIPE FITTING INSTALLATION**

- A. Transition Couplings:
  - 1. Install transition couplings at joints of piping with small differences in ODs.
  - 2. In Waste Drainage Piping: Unshielded or Shielded, nonpressure transition couplings.
- B. Dielectric Fittings:
  - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
  - 2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
  - 3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits or nipples.
  - 4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

### **3.5 VALVE INSTALLATION**

- A. Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping" for general-duty valve installation requirements.

### **3.6 HANGER AND SUPPORT INSTALLATION**

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment." and Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
  - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  - 2. Install stainless-steel or fiberglass pipe hangers for horizontal piping in corrosive environments.
  - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
  - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 6. Install individual, straight, horizontal piping runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  - 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, 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 supports for vertical steel piping every 15 feet.
- I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 2: 84 inches with 3/8-inch rod.
  - 2. NPS 3: 96 inches with 1/2-inch rod.
  - 3. NPS 4: 108 inches with 1/2-inch rod.
  - 4. NPS 6: 10 feet with 5/8-inch rod.
- J. Install supports for vertical stainless-steel piping every 10 feet.
- K. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
  - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  - 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
  - 4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
  - 5. NPS 6: 10 feet with 5/8-inch rod.
  - 6. NPS 8: 10 feet with 3/4-inch rod.
- L. Install supports for vertical copper tubing every 10 feet.
- M. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

### **3.7 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
  - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
  - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  - 5. Comply with requirements for backwater valves cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 6. Equipment: Connect waste piping as indicated.
    - a. Provide shutoff valve if indicated and union for each connection.
    - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. 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 sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### **3.9 FIELD QUALITY CONTROL**

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.



- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
    - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
    - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    - c. Inspect joints for leaks.
  - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
    - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
    - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    - d. Inspect plumbing fixture connections for gas and water leaks.
  - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 6. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.

### **3.10 CLEANING AND PROTECTION**

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Cover all floor drains and floor sinks during constructions to prevent debris from entering pipe and protect grates from damages.
- D. Place plugs in ends of uncompleted piping at end of day and when work stops.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

### **3.11 PIPING SCHEDULE**

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.
  - 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
  - 4. Copper Type DWV tube, copper drainage fittings, and soldered joints.
  - 5. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.
  - 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
  - 4. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Hubless, cast-iron soil pipe and fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.
  - 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
  - 4. Copper Type DWV tube, copper drainage fittings, and soldered joints.
    - a. Option for Vent Piping, NPS 2-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.
  - 5. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.
- E. Aboveground, vent piping NPS 5 and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.
  3. Galvanized-steel pipe, drainage fittings, and threaded joints.
  4. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
1. Extra Heavy or Service class, cast-iron soil piping; gaskets; and gasketed or calking materials; and calked joints.
  2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty cast-iron hubless-piping couplings; and coupled joints.
  3. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.
- G. Underground, soil and waste piping NPS 5 and larger shall be any of the following:
1. Extra Heavy or Service class, cast-iron soil piping; gaskets; and gasketed or calking materials; and calked joints.
  2. Hubless, cast-iron soil pipe and fittings; CISPI or heavy-duty cast-iron hubless-piping couplings; coupled joints.
  3. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.

**END OF SECTION 22 13 16**

**P2S Inc.**  
005.2882.000

January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

## **SECTION 22 13 19 - 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. Roof flashing assemblies.
3. Through-penetration firestop assemblies.
4. Miscellaneous sanitary drainage piping specialties.
5. Floor drains.
6. Floor sinks.

- B. Related Requirements:

1. Section 221423 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.
2. Section 224300 "Healthcare Plumbing Fixtures" for plaster sink interceptors.
3. Section 334200 "Stormwater Conveyance" for storm drainage piping and piping specialties outside the building.

#### **1.3 DEFINITIONS**

- A. ABS: Acrylonitrile-butadiene-styrene.
- B. FOG: Fats, oils, and greases.
- C. PVC: Polyvinyl chloride.
- D. FRP: Fiberglass-reinforced plastic.
- E. HDPE: High-density polyethylene.
- F. PE: Polyethylene.
- G. PP: Polypropylene.

#### 1.4 ACTION SUBMITTALS

- A. Submittals shall be formatted per Section 220000 “General Plumbing Requirements”. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All **exceptions** shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
1. “No Exception Taken”.
  2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. Product Data: For each type of product. Include rated capacities, operating characteristics, and accessories for the following:
1. FOG disposal systems.
- C. Shop Drawings:
1. Show fabrication and installation details for frost-resistant vent terminals.
  2. Wiring Diagrams: Power, signal, and control wiring.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Data: For FOG disposal 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.
- B. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing, and marked for intended location and application.

### 2.2 CLEANOUTS

- A. Cast-Iron Exposed Cleanouts: :
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith Mfg. Co.
    - b. MIFAB, Inc.
    - c. Zurn Industries, LLC.
  - 2. Standard: ASME A112.36.2M.
  - 3. Size: Same as connected drainage piping
  - 4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
  - 5. Closure: Countersunk or raised-head, brass plug.
  - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Cast-Iron Exposed Floor Cleanouts:
  - 1. <Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith Mfg. Co.
    - b. Josam Company.
    - c. Zurn Industries, LLC.
  - 2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing or threaded, adjustable housing cleanout.
  - 3. Size: Same as connected branch.
  - 4. Type: Heavy-duty, adjustable housing or threaded, adjustable housing.
  - 5. Body or Ferrule: Cast iron.
  - 6. Clamping Device: As Required.
  - 7. Outlet Connection: Inside calk, Spigot, or Threaded.
  - 8. Closure: Brass plug with straight threads and gasket or Brass plug with tapered threads.
  - 9. Adjustable Housing Material: Cast iron with threads or setscrews.

10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy Polished bronze, or Rough bronze.
11. Frame and Cover Shape: Round, or Square when specifically requested by owner.
12. Top Loading Classification: Heavy duty at exterior locations. Light or Medium Duty within building.
13. Riser: ASTM A74, Extra-Heavy or Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg. Co.
  - b. MIFAB, Inc.
  - c. Zurn Industries, LLC.
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 Plug:
  - a. Brass Cast iron.
  - b. Countersunk or raised head.
  - c. Drilled and threaded for cover attachment screw.
  - d. Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

## **2.3 ROOF FLASHING ASSEMBLIES**

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acorn Engineering Company.
  - b. Thaler Metal Industries Ltd.
  - c. Zurn Industries, LLC.
2. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
  - a. Open-Top Vent Cap: Without cap.
  - b. Low-Silhouette Vent Cap: With vandal-proof vent cap.



- c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

## 2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

### A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. ProVent Systems.
2. Standard: UL 1479 assembly of sleeve-and-stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. 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.
5. Stack Fitting: ASTM A48/A48M, 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.
6. Special Coating: Corrosion resistant on interior of fittings.

## 2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

### A. 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.

### B. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch to 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

### C. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

### D. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.

2. Size: Same as connected stack vent or vent stack.

E. Expansion Joints:

1. Standard: ASME A112.6.4.
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.

## **2.6 FLOOR DRAINS**

A. Cast-Iron Floor Drains:

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. Jay R. Smith Mfg. Co.
  - b. MIFAB, Inc.
  - c. WATTS.
2. Standard: ASME A112.6.3 with backwater valve where required.
3. Pattern: Area or Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: As Required.
6. Anchor Flange: As Required.
7. Clamping Device: As Required.
8. Outlet: Bottom.
9. Backwater Valve: Drain-outlet type or Integral, ASME A112.14.1, swing-check type.
10. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
11. Sediment Bucket: As Required.
12. Top or Strainer Material: Nickel bronze or Stainless steel.
13. Top of Body and Strainer Finish: Nickel bronze or Stainless steel.
14. Top Shape: Round. Square when specifically requested by owner.
15. Dimensions of Top or Strainer: Refer to Plumbing Fixture Schedule on Construction Plans for body, sump, and grate requirements.
16. Top Loading Classification: Heavy duty at exterior locations. Light or Medium Duty within building.
17. Funnel: Not required.
18. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
19. Trap Material: Bronze, Cast iron or Copper.
20. Trap Pattern: Deep-seal P-trap or Standard P-trap.
21. Trap Features: Trap-seal primer valve drain connection.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install cleanouts in 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 135 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.
  - 5. At each horizontal drainage pipe upper terminal.
  - 6. Above each Urinal.
- 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 roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- E. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- F. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
  - 1. Comply with requirements in Section 078413 "Penetration Firestopping."
- G. 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.
- H. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- I. Install vent caps on each vent pipe passing through roof.
- J. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- K. Install wood-blocking reinforcement for wall-mounting-type specialties.

- L. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- M. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
  - 1. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
    - a. Maintain integrity of waterproof membranes where penetrated.
  - 2. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

### **3.2 CONNECTIONS**

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.
- E. Comply with requirements in Section 221323 "Sanitary Waste Interceptors" for grease interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid interceptors.

### **3.3 FLASHING INSTALLATION**

- A. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- B. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.
- C. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
  - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
  - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
  - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

- D. Set flashing on floors and roofs in solid coating of bituminous cement.
- E. Secure flashing into sleeve and specialty clamping ring or device.
- F. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- G. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

### **3.4 LABELING AND IDENTIFYING**

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the equipment.
- 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.
  - 1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### **3.5 FIELD QUALITY CONTROL**

- A. Perform tests and inspections, and prepare test reports.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

### **3.6 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.

### **3.7 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain FOG disposal systems. Refer to Section 017900 "Demonstration and Training."

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**END OF SECTION 22 13 19**

## SECTION 22 13 23 - SANITARY WASTE INTERCEPTORS

### 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. Solids interceptors.

#### 1.3 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.
- B. PP: Polypropylene plastic.

#### 1.4 ACTION SUBMITTALS

- A. Submittals shall be formatted per Section 220000 "General Plumbing Requirements". The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All **exceptions** shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
  - 1. "No Exception Taken".
  - 2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. Product Data: For each type of metal and plastic interceptor. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.
- C. Shop Drawings: For each type and size of precast concrete interceptor indicated.
  - 1. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Piping connections. Include size, location, and elevation of each.
  - 2. Interface with underground structures and utility services.

## **1.6 FIELD CONDITIONS**

- A. Interruption of Existing Sewer Services: Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sewer services according to requirements indicated:
  - 1. Notify Architect Construction Manager Owner no fewer than seven days in advance of proposed interruption of service.
  - 2. Do not proceed with interruption of sewer services without Architect's Construction Manager's Owner's written permission.

## **PART 2 - PRODUCTS**

### **2.1 SOLIDS INTERCEPTORS**

- A. Cast-Iron Solids Interceptors:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith Mfg. Co.
    - b. MIFAB, Inc.
    - c. Zurn Industries, LLC.
  - 2. Type: Factory-fabricated interceptor made for removing and retaining lint sediment Insert solid from wastewater.
  - 3. Body Material: Cast iron or steel.
  - 4. Interior Separation Device: Screens.
  - 5. Interior Lining: Corrosion-resistant enamel.
  - 6. Exterior Coating: Not required.
  - 7. Inlet and Outlet Size: 3-inch.
  - 8. Mounting: Above floor.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Equipment Mounting:



- B. Set interceptors level and plumb.
- C. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet.
  - 1. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.

### **3.2 CONNECTIONS**

- A. Piping installation requirements are specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Make piping connections between interceptors and piping systems.

### **3.3 IDENTIFICATION**

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Solids interceptors.

### **3.4 PROTECTION**

- A. Protect sanitary waste interceptors from damage during construction period.
- B. Repair damage to adjacent materials caused by sanitary waste interceptor installation.

**END OF SECTION 22 13 23**

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## SECTION 22 14 13 - 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. Hubless, cast-iron soil pipe and fittings.
  - 2. Specialty pipe and fittings.
  - 3. Encasement for underground metal piping.
- B. Related Requirements:
  - 1. Section 221429 "Sump Pumps" for storm drainage pumps.
  - 2. Section 334400 "Stormwater Utility Equipment" for storm drainage piping outside the building.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall be formatted per Section 220000 "General Plumbing Requirements". The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All **exceptions** shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
  - 1. "No Exception Taken".
  - 2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. Product Data: For each type of product.
- C. Sustainable Design Submittals:
  - 1. Product Data: For adhesives, indicating VOC content.
  - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- D. Shop Drawings: For controlled-flow siphonic roof drainage system. Include calculations, plans, and details.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Detail storm drainage piping. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Structural members to which drainage piping will be attached or suspended from.
- B. Field quality-control reports.

#### **1.5 QUALITY ASSURANCE**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

#### **1.6 FIELD CONDITIONS**

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify Architect Owner no fewer than two days in advance of proposed interruption of storm drainage service.
  - 2. Do not proceed with interruption of storm drainage service without Architect's Owner's written permission.

### **PART 2 - PRODUCTS**

#### **2.1 PERFORMANCE REQUIREMENTS**

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  - 1. Storm Drainage Piping: 10-foot head of water.
  - 2. Storm Drainage, Force-Main Piping: 150 psig.

#### **2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AB & I Foundry; a part of the McWane family of companies.
  - 2. Charlotte Pipe and Foundry Company.
  - 3. NewAge Casting.
  - 4. Tyler Pipe; a part of McWane family of companies.

**B. Pipe and Fittings:**

1. Marked with CISPI collective trademark and NSF certification mark.
2. Standard: ASTM A888 or CISPI 301.

**C. CISPI, Hubless-Piping Couplings:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ANACO-Husky.
  - b. Charlotte Pipe and Foundry Company.
  - c. Dallas Specialty & Mfg. Co.
  - d. Fernco Inc.
  - e. Ideal Clamp Products, Inc.
  - f. Matco-Norca.
  - g. MIFAB, Inc.
  - h. Mission Rubber Company, LLC; a division of MCP Industries.
  - i. NewAge Casting.
  - j. Tyler Pipe; a subsidiary of McWane Inc.
2. Couplings shall bear CISPI collective trademark and NSF certification mark.
3. Standards: ASTM C1277 and CISPI 310.
4. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

**D. Heavy-Duty, Hubless-Piping Couplings:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ANACO-Husky.
  - b. Charlotte Pipe and Foundry Company.
  - c. Clamp-All Corp.
  - d. Dallas Specialty & Mfg. Co.
  - e. Ideal Clamp Products, Inc.
  - f. MIFAB, Inc.
  - g. Mission Rubber Company, LLC; a division of MCP Industries.
  - h. NewAge Casting.
  - i. Tyler Pipe; a subsidiary of McWane Inc.
2. Standard: ASTM C1540..
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

**E. Cast-Iron, Hubless-Piping Couplings:**

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

- a. Charlotte Pipe and Foundry Company.
  - b. MG Piping Products Company.
2. Standard: ASTM C1277..
  3. Description: Two-piece ASTM A48/A48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C564, rubber sleeve with integral, center pipe stop.

### 2.3 SPECIALTY PIPE FITTINGS

#### A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODS or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
3. Unshielded, Nonpressure Transition Couplings:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Dallas Specialty & Mfg. Co.
    - 2) Fernco Inc.
    - 3) Mission Rubber Company, LLC; a division of MCP Industries.
    - 4) Plastic Oddities.
  - b. Standard: ASTM C1173.
  - c. Description: Elastomeric sleeve, 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 C564, rubber.
    - 2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
    - 3) For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Cascade Waterworks Mfg. Co.
    - 2) Mission Rubber Company, LLC; a division of MCP Industries.
  - b. Standard: ASTM C1460.
  - 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.
  - d. End Connections: Same size as and compatible with pipes to be joined.

5. Pressure Transition Couplings:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1) Cascade Waterworks Mfg. Co.
  - 2) EBAA Iron, Inc.
  - 3) Ford Meter Box Company, Inc. (The).
  - 4) JCM Industries, Inc.
  - 5) Romac Industries, Inc.
- b. Standard: AWWA C219.
- c. Description: Metal, sleeve-type couplings same size as pipes to be joined, and with pressure rating at least equal to and ends compatible with pipes to be joined.
- d. Center-Sleeve Material: Manufacturer's standard Carbon steel Stainless steel Ductile iron Malleable iron.
- e. Gasket Material: Natural or synthetic rubber.
- f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

- 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- 2. Dielectric Unions:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) A.Y. McDonald Mfg. Co.
    - 2) Capitol Manufacturing Company.
    - 3) Central Plastics Company.
    - 4) HART Industrial Unions, LLC.
    - 5) Jomar Valve.
    - 6) Matco-Norca.
    - 7) WATTS.
    - 8) Zurn Industries, LLC.
  - b. Description:
    - 1) Standard: ASSE 1079.
    - 2) Pressure Rating: 150 psig minimum at 180 deg F.
    - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
- 3. Dielectric Flanges:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Central Plastics Company.
  - 2) Matco-Norca.
  - 3) WATTS.
  - 4) Zurn Industries, LLC.
- b. Description:
- 1) Standard: ASSE 1079.
  - 2) Factory-fabricated, bolted, companion-flange assembly.
  - 3) Pressure Rating: 150 psig minimum at 180 deg F.
  - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
4. Dielectric-Flange Insulating Kits:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1) Advance Products & Systems, Inc.
  - 2) Calpico, Inc.
  - 3) Central Plastics Company.
  - 4) GPT; an EnPro Industries company.
- b. Description:
- 1) Nonconducting materials for field assembly of companion flanges.
  - 2) Pressure Rating: 150 psig.
  - 3) Gasket: Neoprene or phenolic.
  - 4) Bolt Sleeves: Phenolic or polyethylene.
  - 5) Washers: Phenolic with steel-backing washers.
5. Dielectric Nipples:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1) Grinnell G-Fire by Johnson Controls Company.
  - 2) Matco-Norca.
  - 3) Precision Plumbing Products.
  - 4) Victaulic Company.
- b. Description: Electroplated steel nipple.
- c. Standard: IAPMO PS 66.
- d. Pressure Rating: 300 psig at 225 deg F.
- e. End Connections: Male threaded or grooved.
- f. Lining: Inert and noncorrosive, propylene.



## **2.4 ENCASEMENT FOR UNDERGROUND METAL PIPING**

- A. Standard: ASTM A674 or AWWA C105/A 21.5.
- B. Material: High-density, crosslaminated polyethylene film of 0.004-inch or linear low-density polyethylene film of 0.008-inch minimum thickness.
- C. Form: tube.
- D. Color: Black or natural.

## **PART 3 - EXECUTION**

### **3.1 EARTH MOVING**

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

### **3.2 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
  - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
  - 2. Install piping as indicated unless deviations 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. Cover all roof and overflow drains during constructions to prevent debris from entering pipe and protect grates from damages.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.

- J. Install piping to allow application of insulation.
- K. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- L. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.
  - 1. Do not change direction of flow more than 90 degrees.
  - 2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of drainage piping in direction of flow is prohibited.
- M. Lay buried building piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
  - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 3. Maintain swab in piping and pull past each joint as completed.
- N. Install piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Storm Drainage Piping: 2 percent downward in direction of flow.
- O. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
  - 1. Install encasement on underground piping according to ASTM A674 or AWWA C105/A 21.5.
- P. Install engineered controlled-flow siphonic drain specialties and storm drainage piping in locations indicated.
- Q. Plumbing Specialties:
  - 1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping.
    - a. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
    - b. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
  - 2. Install drains in storm drainage gravity-flow piping.
    - a. Comply with requirements for drains specified in Section 221423 "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.
  - 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs.
  - 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### **3.3 JOINT CONSTRUCTION**

- A. Hubless, Cast-Iron Soil Piping Coupled Joints:
  - 1. Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
  - 1. Cut threads full and clean using sharp dies.
  - 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
    - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
    - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
    - c. Do not use pipe sections that have cracked or open welds.
- C. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fittings. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- E. Joint Restraints and Sway Bracing:
  - 1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:

- a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
- b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
- c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.

### **3.4 SPECIALTY PIPE FITTING INSTALLATION**

#### **A. Transition Couplings:**

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force-Main Piping: Fitting-type transition couplings.
4. In Underground Force-Main Piping:
  - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
  - b. NPS 2 and Larger: Pressure transition couplings.

#### **B. Dielectric Fittings:**

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

### **3.5 VALVE INSTALLATION**

#### **A. General valve installation requirements for general-duty valve installations are specified in the following Sections:**

1. Section 220523.12 "Ball Valves for Plumbing Piping."
2. Section 220523.13 "Butterfly Valves for Plumbing Piping."
3. Section 220523.14 "Check Valves for Plumbing Piping."
4. Section 220523.15 "Gate Valves for Plumbing Piping."

#### **B. Shutoff Valves:**

1. Install shutoff valve on each sump pump discharge.
2. Install full port ball valve for piping NS 2 and smaller.
3. Install gate valve for piping NPS 2-1/2 and larger.

#### **C. Check Valves: Install swing-check valve, between pump and shutoff valve, on each sump pump discharge.**

### 3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  - 2. Install stainless-steel fiberglass pipe hangers for horizontal piping in corrosive environments.
  - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
  - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 6. Install individual, straight, horizontal piping runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  - 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. 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 pipe 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 supports for vertical steel piping every 15 feet.
- I. Support piping and tubing not listed above according to MSS SP-58 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 221423 "Storm Drainage Piping Specialties."
- D. Connect force-main piping to the following:
  - 1. Storm Sewer: To exterior force main.
  - 2. Sump Pumps: To sump pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance.
- F. Make connections according to the following unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### 3.8 IDENTIFICATION

- A. Identify exposed storm drainage piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  3. Test Procedure:
    - a. Test storm drainage piping on completion of roughing-in.
    - b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
  4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  5. Prepare reports for tests and required corrective action.
- C. Piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### **3.10 CLEANING AND PROTECTION**

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

### **3.11 PIPING SCHEDULE**

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground storm drainage piping NPS 6 and smaller shall be any of the following:
  1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, hubless-piping couplings; and coupled joints.
  3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, storm drainage piping NPS 8 and larger shall be any of the following:
  1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, hubless-piping couplings; and coupled joints.
  3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Underground storm drainage piping NPS 6 and smaller shall be any of the following:
1. Extra Heavy Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, cast-iron, hubless-piping couplings; and coupled joints.
  3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Underground, storm drainage piping NPS 8 and larger shall be any of the following:
1. Extra Heavy Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, cast-iron, hubless-piping couplings; and coupled joints.
  3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- F. Aboveground storm drainage force mains NPS 2-1/2 to NPS 6 shall be any of the following:
1. Hard copper tube, Type L copper pressure fittings, and soldered joints.
  2. Galvanized-steel pipe, pressure fittings, and threaded joints.
  3. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
  4. Fitting-type transition couplings if dissimilar pipe materials.
- G. Underground storm drainage force mains NPS 4 and smaller shall be any of the following:
1. Hard copper tube; Type L wrought-copper pressure fittings; and soldered joints.
  2. Ductile-iron, mechanical-joint piping and mechanical joints.
  3. Ductile-iron, push-on-joint piping and push-on joints.
  4. Ductile-iron, grooved-joint piping and grooved joints.
  5. Fitting-type transition coupling for piping smaller than NPS 1-1/2 and pressure transition coupling for NPS 1-1/2 and larger if dissimilar pipe materials.

**END OF SECTION 22 14 13**



## SECTION 22 14 23 - 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. Metal roof drains.
  - 2. Miscellaneous storm drainage piping specialties.
  - 3. Cleanouts.
- B. Related Requirements:
  - 1. Section 076200 "Sheet Metal Flashing and Trim" for penetrations of roofs.
  - 2. Section 078413 "Penetration Firestopping" for firestopping roof penetrations.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall be formatted per Section 220000 "General Plumbing Requirements". The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All **exceptions** shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
  - 1. "No Exception Taken".
  - 2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. Product Data: For each type of product.

#### 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, General-Purpose Roof Drains:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg. Co.
  - b. MIFAB, Inc.
  - c. Zurn Industries, LLC.
2. Standard: ASME A112.6.4.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 14-to 16-inch diameter.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Flow-Control Weirs: Required.
7. Outlet: Bottom or Side.
8. Outlet Type: No hub or Threaded.
9. Extension Collars: Required.
10. Underdeck Clamp: Required.
11. Sump Receiver Plate: Required.
12. Dome Material: Aluminum Cast iron PE.
13. Perforated Gravel Guard: Stainless steel.
14. Water Dam: Not required.

### **2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES**

#### **A. Conductor Nozzles:**

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

### **2.3 CLEANOUTS**

#### **A. Cast-Iron Exposed Cleanouts:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg. Co.
  - b. MIFAB, Inc.
  - c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M.
3. Size: Same as connected branch.

4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch No-hub, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

**B. Cast-Iron Wall Cleanouts:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg. Co.
  - b. MIFAB, Inc.
  - c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: No-hub, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:
  - a. Brass Cast iron.
  - b. Countersunk or raised head.
  - c. Drilled and threaded for cover attachment screw.
  - d. Size: Same as, or not more than, one size smaller than cleanout size.
6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

**C. Test Tees:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg. Co.
  - b. MIFAB, Inc.
  - c. Tyler Pipe; a subsidiary of McWane Inc.
2. Standard: ASME A112.36.2M and ASTM A74, ASTM A888, or CISPI 301.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or no-hub, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug: Countersunk or raised head, brass.
6. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

## **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 conductor nozzles at exposed bottom of conductors where they spill onto grade.
- C. Install cleanouts in 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 135 degrees.
  - 3. Locate cleanouts at base of each vertical storm piping conductor.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install test tees in vertical conductors and near floor.
- G. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.
- H. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.
  - 1. Comply with requirements in Section 078413 "Penetration Firestopping."

### **3.2 CONNECTIONS**

- A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

### **3.3 FLASHING INSTALLATION**

- A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.

- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.

**3.4 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 22 14 23**

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## **SECTION 22 15 13 - GENERAL-SERVICE COMPRESSED-AIR 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. This Section includes piping and related specialties for general-service compressed-air systems:
  - 1. Pipes, tubes, and fittings.
  - 2. Joining materials.
  - 3. Valves.
  - 4. Dielectric fittings.
  - 5. Flexible pipe connectors.
  - 6. Specialties.
  - 7. Quick couplings.
  - 8. Hose assemblies.
- B. Related Sections include the following:
  - 1. Section 221519 "General-Service Packaged Air Compressors and Receivers" for general-service air compressors and accessories.

#### **1.3 DEFINITIONS**

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.
- C. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig or less.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Compressed-air piping and support and installation shall withstand effects of seismic events determined according to SEI/ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

## 1.5 ACTION SUBMITTALS

- A. Submittals shall be formatted per Section 220000 "General Plumbing Requirements". The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All **exceptions** shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
1. "No Exception Taken".
  2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. Product Data: For the following:
1. Plastic pipes, fittings, and valves.
  2. Dielectric fittings.
  3. Flexible pipe connectors.
  4. Safety valves.
  5. Pressure regulators. Include rated capacities and operating characteristics.
  6. Automatic drain valves.
  7. Filters. Include rated capacities and operating characteristics.
  8. Lubricators. Include rated capacities and operating characteristics.
  9. Quick couplings.
  10. Hose assemblies.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Brazing certificates.
- B. Qualification Data: For installers.
- C. Field quality-control test reports.

## 1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For general-service compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

## 1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
- B. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."



- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- D. ASME Compliance:
  - 1. Comply with ASME B31.1, "Power Piping," for high-pressure compressed-air piping.
  - 2. Comply with ASME B31.3, "Process Piping," for high- and low-pressure compressed-air piping.
  - 3. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

## **1.9 PROJECT CONDITIONS**

- A. Interruption of Existing Compressed-Air Service: Do not interrupt compressed-air service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary compressed-air service according to requirements indicated:
  - 1. Notify Owner no fewer than five days in advance of proposed interruption of compressed-air service.
  - 2. Do not proceed with interruption of compressed-air service without Owner's written permission.

## **PART 2 - PRODUCTS**

### **2.1 PIPES, TUBES, AND FITTINGS**

- A. Copper Tube: ASTM B88, Type K or L seamless, drawn-temper, water tube.
  - 1. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
  - 2. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300.
  - 3. Copper Unions: ASME B16.22 or MSS SP-123.
- B. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

### **2.2 JOINING MATERIALS**

- A. Pipe-Flange Gasket Materials: Suitable for compressed-air piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.
- E. 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.

### **2.3 VALVES**

- A. Metal Ball, Butterfly, Check, and Gate Valves: Comply with requirements in Section 220523 "General Duty Valves for Plumbing Piping."

### **2.4 DIELECTRIC FITTINGS**

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Capitol Manufacturing Company.
    - b. Wilkins.
  - 2. Description:
    - a. Standard: ASSE 1079.
    - b. Pressure Rating: 125 psig minimum at 180 deg F.
    - c. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Capitol Manufacturing Company.
    - b. Wilkins.
  - 2. Description:
    - a. Standard: ASSE 1079.
    - b. Factory-fabricated, bolted, companion-flange assembly.
    - c. Pressure Rating: 125 psig minimum at 180 deg F.

- d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Advance Products & Systems, Inc.
  - b. Calpico, Inc.
  - c. 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.

## **2.5 FLEXIBLE PIPE CONNECTORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Flex-Hose Co., Inc.
  2. Flexicraft Industries.
  3. Metraflex Company.
- B. Bronze-Hose Flexible Pipe Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
  1. Working-Pressure Rating: 200 psig minimum.
  2. End Connections, NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
  3. End Connections, NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
  1. Working-Pressure Rating: 200 psig minimum.
  2. End Connections, NPS 2 and Smaller: Threaded steel pipe nipple.
  3. End Connections, NPS 2-1/2 and Larger: Flanged steel nipple.

## **2.6 SPECIALTIES**

- A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.

1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.
- B. Air-Line Pressure Regulators: Diaphragm or pilot operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.
- C. Air-Line Pressure Regulators: Diaphragm operated, aluminum alloy or plastic body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.
- D. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket if wall mounting is indicated.
- E. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Include mounting bracket if wall mounting is indicated.
- F. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock. Include mounting bracket if wall mounting is indicated.
- G. Air-Line Lubricators: With drip chamber and sight dome for observing oil drop entering air stream; with oil-feed adjustment screw and quick-release collar for easy bowl removal. Include mounting bracket if wall mounting is indicated.
  1. Provide with automatic feed device for supplying oil to lubricator.

## **2.7 QUICK COUPLINGS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Aeroquip Corporation.
  2. Milton Industries, Inc.
  3. Parker Hannifin Corp.
- B. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
- C. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.
  1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
  2. Plug End: Straight-through type with barbed outlet for attaching hose.

- D. Valve less Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.
  - 1. Socket End: With O-ring or gasket seal, without valve, and with barbed inlet for attaching hose.
  - 2. Plug End: With barbed outlet for attaching hose.

## **2.8 HOSE ASSEMBLIES**

- A. Description: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless otherwise indicated.
  - 1. Hose: Reinforced double-wire-braid, CR-covered hose for compressed-air service.
  - 2. Hose Clamps: Stainless-steel clamps or bands.
  - 3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with barbed ends for connecting two sections of hose.
  - 4. Hose Splicers: One-piece, straight-through brass or stainless-steel fitting with barbed ends for connecting two sections of hose.

## **PART 3 - EXECUTION**

### **3.1 PIPING APPLICATIONS**

- A. Compressed-Air Distribution Piping: Use the following piping materials for each size range:
  - 1. NPS 2 and Smaller: Type L, copper tube; wrought-copper fittings; and brazed or soldered joints.
- B. Drain Piping: Use the following piping materials:
  - 1. NPS 2 and Smaller: Type M copper tube; wrought-copper fittings; and brazed or soldered joints.

### **3.2 VALVE APPLICATIONS**

- A. Metal General-Duty Valves: Comply with requirements and use valve types specified in "Valve Applications" Articles in Section 220523 "General Duty Valves for Plumbing Piping," according to the following:
  - 1. Compressed Air: Valve types specified for low-pressure compressed air.

### **3.3 PIPING INSTALLATION, GENERAL**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate

friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- B. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.
- E. Install piping adjacent to equipment and machines to allow service and maintenance.
- F. Install air and drain piping with 1 percent slope downward in direction of flow.
- G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.
- H. Equipment and Specialty Flanged Connections:
  - 1. Use steel companion flange with gasket for connection to steel pipe.
  - 2. Use cast-copper-alloy companion flange with gasket and brazed joint for connection to copper tube. Do not use soldered joints for connection to air compressors or to equipment or machines producing shock or vibration.
- I. Flanged joints may be used instead of specified joint for any piping or tubing system.
- J. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- K. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
- L. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 220519 "Meters and Gages for Plumbing Piping."
- M. Install piping to permit valve servicing.
- N. Install piping free of sags and bends.
- O. Install fittings for changes in direction and branch connections.
- P. Install seismic restraints on piping. Seismic-restraint devices are specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

- R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "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 220518 "Escutcheons for Plumbing Piping."

### **3.4 JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Brazed Joints for Copper Tubing: Join according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- E. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Join according to ASTM B828 or CDA's "Copper Tube Handbook."
- F. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

### **3.5 VALVE INSTALLATION**

- A. General-Duty Valves: Comply with requirements in Section 220523 "General Duty Valves for Plumbing Piping."
- B. Provide shutoff valves and unions or flanged joints at compressed-air piping to air compressors.
- C. Install shutoff valve at inlet to each automatic drain valve, filter, lubricator, and pressure regulator.
- D. Provide check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

### **3.6 DIELECTRIC FITTING INSTALLATION**

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. NPS 2 and Smaller: Use dielectric unions.

### **3.7 FLEXIBLE PIPE CONNECTOR INSTALLATION**

- A. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.
- B. Install bronze-hose flexible pipe connectors in copper compressed-air tubing.
- C. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

### **3.8 SPECIALTY INSTALLATION**

- A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.
- B. Install air-main pressure regulators in compressed-air piping at or near air compressors.
- C. Install air-line pressure regulators in branch piping to equipment and tools.
- D. Install automatic drain valves on aftercoolers, receivers, and dryers. Discharge condensate onto nearest floor sink.
- E. Install coalescing filters in compressed-air piping at or near air compressors and upstream from mechanical filters.
- F. Install mechanical filters in compressed-air piping at or near air compressors and downstream from coalescing filters.
- G. Install air-line lubricators in branch piping to machine tools.
- H. Install quick couplings at piping terminals for hose connections.
- I. Install hose assemblies at hose connections.

### **3.9 CONNECTIONS**

- A. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.
- B. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment and machine.

### **3.10 HANGER AND SUPPORT INSTALLATION**

- A. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.



- B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

### **3.11 LABELING AND IDENTIFICATION**

- A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."

### **3.12 FIELD QUALITY CONTROL**

- A. Perform field tests and inspections.
- B. Tests and Inspections:
  - 1. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
  - 2. Repair leaks and retest until no leaks exist.
  - 3. Inspect filters lubricators and pressure regulators for proper operation.
- C. Prepare test reports.

**END OF SECTION 22 15 13**

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## SECTION 22 15 19 - GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS

### 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. Oil-free, rotary-screw air compressors.
  - 2. Oil-flooded, rotary-screw air compressors.
  - 3. Inlet-air filters.

#### 1.3 DEFINITIONS

- A. Actual Air: Air delivered from air compressors. Flow rate is delivered compressed air measured in acfm.
- B. Standard Air: Free air at 68 deg F and 1 atmosphere before compression or expansion and measured in scfm.

#### 1.4 ACTION SUBMITTALS

- A. Submittals shall be formatted per Section 220000 "General Plumbing Requirements". The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All **exceptions** shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
  - 1. "No Exception Taken".
  - 2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- C. Shop Drawings:
  - 1. Include diagrams for power, signal, and control wiring.

- D. Delegated-Design Submittal: For compressed-air equipment mounting.
  - 1. Detail fabrication and assembly of supports.
  - 2. Include design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

## **1.5 INFORMATIONAL SUBMITTALS**

- A. Seismic Qualification Certificates: For compressed-air 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.

## **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For compressed-air equipment 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. Air-Compressor, Inlet-Air-Filter Elements: Equal to two percent of amount installed, but no fewer than units.
  - 2. Belts: Two for each belt-driven compressor.

## **1.8 FIELD CONDITIONS**

- A. Interruption of Existing Compressed-Air Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify Owner no fewer than five days in advance of proposed interruption of compressed-air service.
  - 2. Do not proceed with interruption of compressed-air service without Owner's written permission.

## **1.9 COORDINATION**

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

## **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. ASME Compliance: Fabricate and label receivers to comply with ASME Boiler and Pressure Vessel Code.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design compressed-air equipment mounting.
- B. Seismic Performance: Compressed-air equipment 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."

### **2.3 GENERAL REQUIREMENTS FOR PACKAGED AIR COMPRESSORS AND RECEIVERS**

- A. General Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.
- B. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.
  - 1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
  - 2. Motor Controllers: Full-voltage, combination magnetic type with undervoltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
  - 3. Control Voltage: 120-V ac or less, using integral control power transformer.
  - 4. Motor Overload Protection: Overload relay in each phase.
  - 5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
  - 6. Automatic control switches to alternate lead-lag compressors for duplex sequence lead-lag compressors for multiplex air compressors.
  - 7. Instrumentation: Include discharge-air pressure gage, air-filter maintenance indicator, hour meter, compressor discharge-air and coolant temperature gages, and control transformer.

8. Alarm Signal Device: For connection to alarm system to indicate when backup air compressor is operating.
- C. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
  1. Pressure Rating: At least as high as highest discharge pressure of connected compressors, and bearing appropriate code symbols.
  2. Interior Finish: Corrosion-resistant coating.
  3. Accessories: Include safety valve, pressure gage, drain, and pressure-reducing valve.
- D. Mounting Frame: Fabricate mounting and attachment to pressure vessel with reinforcement strong enough to resist packaged equipment movement during a seismic event when base is anchored to building structure.
- E. See equipment schedule on drawings for additional information.

## **2.4 ROTARY-SCREW AIR COMPRESSORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Chicago Pneumatic.
  2. Atlas Copco.
  3. Ingersoll-Rand.
- B. Compressor(s): rotary-screw type with nonlubricated helical screws and lubricated gear box, and of construction that prohibits oil from entering compression chamber.
  1. Coupling: Nonlubricated, flexible type.
  2. Cooling/Lubrication System: Unit-mounted, air-cooled exchanger package prepiped to unit; with air pressure circulation system with coolant stop valve, full-flow coolant filter, and thermal bypass valve.
  3. Air Filter: Dry type, with maintenance indicator and cleanable, replaceable filter element.
  4. Air/Coolant Receiver and Separation System: 150-psig- rated steel tank with ASME safety valve, coolant-level gage, multistage air-coolant separator element, minimum pressure valve, blowdown valve, discharge check valve, coolant stop valve, full-flow coolant filter, and thermal bypass valve.
  5. Capacity Control: Capacity modulation between zero and 100 percent air delivery, with operating pressures between 50 and 100 psig. Include necessary control to hold constant pressure. When air demand is zero, unload compressor by using pressure switch and blowdown valve.
- C. Capacities and Characteristics: See equipment schedule on drawings.

## **2.5 INLET-AIR FILTERS**

- A. Description: Combination inlet-air filter-silencer, suitable for remote installation, for each air compressor.
  - 1. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
  - 2. Capacity: Match capacity of air compressor, with filter having collection efficiency of 99 percent retention of particles larger than 10 micrometers.
  
- B. Description: Combination inlet-air filter-silencer, suitable for remote installation, for multiple air compressors.
  - 1. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
  - 2. Capacity: Match total capacity of connected air compressors, with filter having collection efficiency of 99 percent retention of particles larger than 10 micrometers.

## **2.6 MOTORS**

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
  - 1. Enclosure: Totally enclosed, fan cooled.
  - 2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load does not require motor to operate in service factor range above 1.0.

## **PART 3 - EXECUTION**

### **3.1 EQUIPMENT INSTALLATION**

- A. Equipment Mounting:
  - 1. Install air compressors package on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033053 "Miscellaneous Cast-in-Place Concrete."
  - 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment"
  - 3. Comply with requirements for vibration isolation devices specified in Section 220548 "Vibration Controls for Plumbing Piping and Equipment."
  
- B. Install compressed-air equipment anchored to substrate.
  
- C. Arrange equipment so controls and devices are accessible for servicing.
  
- D. Maintain manufacturer's recommended clearances for service and maintenance.

- E. Provide the following devices on compressed-air equipment:
1. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
  2. Pressure Regulators: Install downstream from air compressors and dryers.
  3. Automatic Drain Valves: Install on aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

### **3.2 CONNECTIONS**

- A. Comply with requirements for piping specified in Section 221513 "General-Service Compressed-Air Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to machine, allow space for service and maintenance.

### **3.3 IDENTIFICATION**

- A. Identify general-service air compressors and components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### **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. Check for lubricating oil in lubricated-type equipment.
  3. Check belt drives for proper tension.
  4. Verify that air-compressor inlet filters and piping are clear.
  5. Check for equipment vibration-control supports and flexible pipe connectors, and verify that equipment is properly attached to substrate.
  6. Check safety valves for correct settings. Ensure that settings are higher than air-compressor discharge pressure, but not higher than rating of system components.
  7. Check for proper seismic restraints.
  8. Drain receiver tanks.
  9. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  10. Test and adjust controls and safeties.

### **3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air compressors, aftercoolers, and air dryers.

**END OF SECTION 22 15 19**



## **SECTION 22 16 19 - DISINFECTION OF POTABLE WATER SYSTEM**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This section includes the furnishing of all labor and materials for disinfection of the potable water system. Potable water systems are those systems which carry domestic water from the supply main without isolation of the branch by a backflow prevention device. Install all plumbing fittings and valves necessary to perform the disinfection.
- B. This section also includes the furnishing of all labor and materials to sample water in system following completion of procedure and provide bacteriological analysis of the water.

#### **1.2 QUALIFICATIONS**

- A. Disinfection: Disinfection shall be done by a commercial disinfection company approved by the College. Submit to the College's Representative the name of the proposed company for approval.
- B. Bacteriological Analysis: Water testing shall be done by a laboratory approved by the State Department of Health Services. Submit for approval the name of the proposed laboratory as well as the proposed number and location of samples.
- C. Provide a certificate of completion per Part B attached standard chlorination report which denotes the lines disinfected, the concentration applied and the amount and type of disinfection agent used, and that disinfection is in accordance with AWWA C-601 and State Health Department requirements.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Use an approved chlorine agent, applied in liquid form into the system being disinfected. Chlorine gas or a hypochlorite solution may be used to make up the disinfecting liquid.

## **PART 3 - EXECUTION**

### **3.1 PRELIMINARY PREPARATION OF THE SYSTEM**

- A. Provide within 3 feet of the supply main, an injection port for introducing the chlorine solution and a gate valve upstream from the injection port.
- B. There shall be no dead-end sections in the system exceeding 3 feet in length. All branches within the system shall lead to an outlet for bleeding and flushing.
- C. After final pressure tests, open each fixture or outlet to maximum flow and run until the discharge water is free from particulates.

### **3.2 CHLORINATION PROCEDURE**

- A. Notify the College's Representative at least five working days prior to the start date of chlorination per Part A attached chlorination report.
- B. Install all fixtures to be served by the potable water system before start of chlorination.
- C. Prior to injection, place signs on each fixture being treated, reading "Heavily Chlorinated Water - Do Not Use."
- D. Introduce the chlorine into the supply stream at a rate to provide a uniform concentration of chlorine in the entire system. Maintain at least 50 ppm chlorine level at each fixture after a hold period of 24 hours. Do not exceed 150 ppm at any time.
- E. Draw the injected chlorine in the system through each outlet and fixture until the specified concentration level is reached. Then close all valves including the service cock and supply valve. Keep the system closed during the 24 hour hold period.
- F. The College will require a test for the residual concentration in the system at the end of 24 hours. Release no water from the system until these required samples are taken. A minimum concentration of 50 ppm of chlorine is required at all chosen sampling points.
- G. After approval to proceed, flush the system at a relatively high velocity to remove the injected chlorine to a concentration in the system of no more than 0.5 ppm above that in the normal supply.
- H. After approval to proceed, secure the entire system for at least three days prior to taking samples for bacteriological analysis.

### **3.3 SAMPLING AND NOTIFICATION**

- A. At the completion of the three day hold period, take bacteriological water samples with observation by the College's Representative.

- B. Sample bottles must be provided by the approved laboratory. After the samples have been collected, the College's Representative may allow temporary use of the water system pending results of the bacteriological analysis of the samples. The system cannot be used unless such allowance in writing is given.
- C. Upon completion of sampling, submit the certificate of completion to the College's Representative for approval.

### **3.4 ANALYSIS**

- A. Perform qualitative and quantitative bacterial analysis on the water samples and submit a laboratory report. The report must include the presence of any E. Coli bacteria in a 100 ml sample (this must be negative to be acceptable) and a total plate count of bacteria per cc of the sample (this must be less than 100, or equal to the supply).

### **3.5 FINAL ACCEPTANCE**

- A. Upon satisfactory completion of all procedures and receipt of acceptable bacteriological results, written approval of the system will be provided by the College's Representative per Part C attached standard chlorination report. Failure to fully comply with the above procedures will result in a requirement to repeat the procedure until acceptable results are achieved, at no additional cost to the College.

**END OF SECTION 22 16 19**

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## **SECTION 22 19 19 - SANITARY WASTE, STORM DRAIN, VENT PIPE AND FITTINGS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes soil and waste, sanitary drainage, vent and storm drain piping inside the building.

#### **1.2 SUBMITTALS**

- A. Field quality-control test reports.

#### **1.3 QUALITY ASSURANCE**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

### **PART 2 - PRODUCTS**

#### **2.1 PIPING MATERIALS**

- A. Flexible Transition Couplings for Underground Non-pressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends of same sizes as piping to be joined and include corrosion-resistant metal band on each end.
- B. Transition Couplings for Underground Pressure Piping: AWWA C219 metal, sleeve-type coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- C. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
  - 1. Couplings: ASTM C 1277 assembly of metal housing, corrosion-resistant fasteners, and ASTM C 564 rubber sleeve with integral, center pipe stop for below grade, under slab installation.
    - a. Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM A 666, Type 304, stainless-steel shield; stainless-steel bands; and sleeve.
      - 1) NPS 1-1/2 to NPS 4: 3-inch-wide shield with 4 bands.
      - 2) NPS 5 to NPS 10: 4-inch-wide shield with 6 bands.
    - b. Heavy-Duty, Cast-Iron Couplings: ASTM A 48, 2-piece, cast-iron housing; stainless-steel bolts and nuts; and sleeve.

- c. Compact, Stainless-Steel Couplings: CISPI 310 with ASTM A 167, Type 301, or ASTM A 666, Type 301, stainless-steel corrugated shield; stainless-steel bands; and sleeve for above grade.
  - 1) NPS 1-1/2 to NPS 4: 2-1/8-inch-wide shield with 2 bands.
  - 2) NPS 5 and NPS 6: 3-inch-wide shield with 4 bands.
  - 3) NPS 8 and NPS 10: 4-inch-wide shield with 4 bands.
  - 4) NPS 12 and NPS 15: 5-1/2-inch-wide shield with 6 bands.
- D. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.
  - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
  - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

## **PART 3 - EXECUTION**

### **3.1 PIPING APPLICATIONS**

- A. Transition and special fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Aboveground, Soil, Waste, Storm Drain and Vent Piping: Use the following piping materials for each size range:
  - 1. NPS 1-1/4 and NPS 1-1/2: Steel pipe; cast-iron, threaded drainage fittings; and threaded joints.
  - 2. NPS 1-1/4 and NPS 1-1/2: Copper DWV tube, copper drainage fittings, and soldered joints.
  - 3. NPS 1 1/2 to NPS 4: Hubless, cast-iron soil piping.
- C. Underground, Soil, Waste, Storm Drain and Vent Piping: Use the following piping materials for each size range:
  - 1. NPS 1 1/2 to NPS 4: Service class, cast-iron soil piping; gaskets; and gasketed joints.
  - 2. NPS 1 1/2 to NPS 4: Hubless, cast-iron soil piping.

### **3.2 PIPING INSTALLATION**

- A. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- B. Install cleanouts at grade and extend to where building storm drains connect to building storm drain system.

- C. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Division 22 Section 22 05 17 "Sleeves and Sleeve Seals For Plumbing Piping.
- D. 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."
- E. 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 2 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.
- F. 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.
- G. Install soil, waste, storm 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.
- H. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- I. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

### 3.3 JOINT CONSTRUCTION

- A. Refer to Division 22 Section 22 11 16 "Domestic Water Pipe and Fittings for basic piping joint construction.
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
  - 1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
  - 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 22 Section 22 05 29 "Hangers and Supports For Plumbing Piping and Equipment.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- D. 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: 60 inches with 3/4-inch rod.
  - 5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- E. Install supports for vertical cast-iron soil piping every 15 feet.

### 3.5 CONNECTIONS

- A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- B. 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. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection.

### 3.6 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.
  - 1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 2. Prepare reports for tests and required corrective action.

### **3.7 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.

**END OF SECTION 22 19 19**

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## SECTION 22 33 00 - ELECTRIC, DOMESTIC-WATER HEATERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Commercial, electric, domestic-water booster heaters.
  - 2. Commercial, electric, storage, domestic-water heaters.
  - 3. Commercial, light-duty, storage, electric, domestic-water heaters.
  - 4. Flow-control, electric, tankless, domestic-water heaters.
  - 5. Thermostat-control, electric, tankless, domestic-water heaters.
  - 6. Domestic-water heater accessories.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall be formatted per Section 220000 "General Plumbing Requirements". The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All **exceptions** shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
  - 1. "No Exception Taken".
  - 2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- C. Sustainable Design Submittals:
  - 1. Product Data: For energy efficiency.
- D. Shop Drawings:
  - 1. Include diagrams for power, signal, and control wiring.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale, on which the items described in this Section are shown and coordinated with all building trades.
- B. Seismic Qualification Data: Certificates, for commercial domestic-water heaters, 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. Product Certificates: For each type of commercial and tankless, electric, domestic-water heater.
- D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Sample Warranty: For special warranty.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For electric, domestic-water heaters to include emergency, operation, and maintenance manuals.

#### **1.6 COORDINATION**

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

#### **1.7 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including storage tank and supports.
    - b. Faulty operation of controls.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Periods: From date of Substantial Completion.

- a. Commercial, Electric, Domestic-Water Booster Heaters:
  - 1) Controls and Other Components: Three years.
- b. Commercial, Electric, Storage, Domestic-Water Heaters:
  - 1) Storage Tank: Five years.
  - 2) Controls and Other Components: Five years.
- c. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
  - 1) Storage Tank: Five years.
  - 2) Controls and Other Components: Three years.
- d. Electric, Tankless, Domestic-Water Heaters: Five year(s).
- e. Expansion Tanks: Five years.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. Seismic Performance: Commercial, electric, domestic-water heaters shall withstand the effects of earthquake motions determined in accordance with 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. Component Importance Factor: 1.0.
- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.
- D. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- E. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

### **2.2 ELECTRIC, TANKLESS, DOMESTIC-WATER HEATERS**

- A. Flow-Control, Electric, Tankless, Domestic-Water Heaters:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Eemax, Inc.
  - b. Chronomite Laboratories, Inc.
  - c. Stiebel Eltron, Inc.
2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
  3. Standard: UL 499 for electric, tankless, (domestic-water-heater) heating appliance.
  4. Construction: Copper piping or tubing complying with NSF 61 and NSF 372 barrier materials for potable water, without storage capacity.
    - a. Connections: ASME B1.20.1 pipe thread.
    - b. Pressure Rating: 150 psig.
    - c. Heating Element: Resistance heating system.
    - d. Temperature Control: Flow-control fitting.
    - e. Safety Control: High-temperature-limit cutoff device or system.
    - f. Jacket: Aluminum or steel with enameled finish or plastic.
  5. Support: Bracket for wall mounting.

### **2.3 DOMESTIC-WATER HEATER ACCESSORIES**

- A. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1 ASHRAE 90.2.
- B. Heat-Trap Fittings: ASHRAE/IES 90.1 ASHRAE 90.2.
- C. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- D. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- E. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

### **2.4 SOURCE QUALITY CONTROL**

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

## **PART 3 - EXECUTION**

### **3.1 DOMESTIC-WATER HEATER INSTALLATION**

- A. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters at least 18 inches above floor on wall bracket.
  - 1. Maintain manufacturer's recommended clearances.
  - 2. Arrange units so controls and devices that require servicing are accessible.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 5. Anchor domestic-water heaters to substrate.
- B. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install commercial, electric, domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- D. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

### **3.2 PIPING CONNECTIONS**

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

### **3.3 IDENTIFICATION**

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### **3.4 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

**3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial and tankless, electric, domestic-water heaters. Training shall be a minimum of one hour(s).

**END OF SECTION 22 33 00**



## SECTION 22 40 00 - PLUMBING FIXTURES

### 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. This Section includes the following conventional plumbing fixtures and related components:

1. Water closets.
2. Water closet flushometer valves and tanks.
3. Toilet seats.
4. Lavatories.
5. Lavatory faucets.
6. Sinks.
7. Lounge Sink faucet.
8. Classroom sink faucets.
9. Disposer.
10. Supports.
11. Supply fittings.
12. Waste fittings.
13. Grout.

- B. Related Requirements:

1. Section 224713 "Drinking Fountains" for drinking fountain units.

#### 1.3 DEFINITIONS

- A. Effective Flush Volume: Average of two reduced flushes and one full flush per fixture.
- B. Remote Water Closet: Located more than 30 feet from other drain line connections or fixture and where less than 1.5 drainage fixture units are upstream of the drain line connection.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

3. Shop Drawings: Include diagrams for power, signal, and control wiring.

## 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.
  1. Water Closet Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.
  2. Urinal Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

## PART 2 - PRODUCTS (See fixture schedule for additional information)

### 2.1 WATER CLOSETS

- A. Water Closets: Wall mounted, top spud, accessible.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Standard.
    - b. Kohler Co.
    - c. Sloan Valve Company.
  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. Flushometer: Hardwired. See plumbing fixture schedule.
  4. Toilet Seat: See plumbing fixture schedule.
  5. Support: Water closet carrier.
  6. Water-Closet Mounting Height: Refer architectural drawings.

## **2.2 FLUSHOMETER VALVES.**

### **A. Hard-Wired, Solenoid-Actuator, Piston Flushometer Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Moen.
  - b. Sloan Valve Company.
  - c. Zurn Industries, LLC.
2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. 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.

## **2.3 TOILET SEATS**

### **A. Toilet Seats: For Wall mounted flushometer water closets**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Bemis Manufacturing Company.
  - b. Church Seats; Bemis Manufacturing Company.
  - c. Olsonite Seat Co.
2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Standard) or Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.

## **2.4 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES**

- A. Lavatory: Rectangular, vitreous china, under counter mounted.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Kohler Co.
    - b. American Standard
    - c. Gerber Plumbing Fixtures LLC.
  - 2. Fixture:
    - a. Standard: ASME A112.19.2/CSA B45.1.
    - b. Type: Self-rimming for above-counter mounting.
    - c. Nominal Size: Rectangular, 17 by 13 inches.
    - d. Faucet-Hole Punching: One hole.
    - e. Faucet-Hole Location: Top.
    - f. Color: White.
    - g. Mounting Material: Sealant.
  - 3. Faucet: Hard-wired. See plumbing fixture schedule.

## **2.5 LAVATORY FAUCETS**

- A. NSF Standard: Comply with NSF 372 for faucet materials that will be in contact with potable water.
- B. Lavatory Faucets: Automatic-type, hard-wired, electronic-sensor-operated, mixing, solid-brass valve.
  - 1. Manufacturers: Moen CA8302 or provide products by one of the following:
    - a. Chicago Faucets; Geberit Company.
    - b. Sloan Valve Company.
  - 2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
  - 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: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
  - 5. Body Type: Single hole.
  - 6. Body Material: Commercial, solid brass.
  - 7. Finish: Polished chrome plate.
  - 8. Maximum Flow Rate: 0.5 gpm.
  - 9. Mounting Type: Deck.
  - 10. Spout: Rigid type.

## 2.6 SINKS

A. Sinks: S-1: counter mounted, stainless steel. See schedule for additional information.

1. Stainless-Steel Sinks:

a. Manufacturers: Elkay LRAD2219R or provide products by one of the following:

- 1) Just Manufacturing.
- 2) Franke Consumer Products, Inc.

2. Fixture:

- a. Standard: ANSI Z124.3 and ANSI/ICPA SS-1 for solid-surface kitchen sinks.
- b. Standard: ASME A112.19.3/CSA B45.4 for stainless-steel kitchen sinks.
- c. Overall Dimensions: See plumbing fixture schedule.
- d. Metal Thickness: 18 gauge.
- e. Bowl:

- 1) Dimensions: See plumbing fixture schedule
- 2) Drain: 3-1/2-inch crumb cup or outlet for disposer.

a) Location: Rear-Centered in bowl location.

3. Faucet: Comply with the requirements in "Sink Faucets" Article.
4. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
5. Waste Fittings: Comply with requirements in "Waste Fittings" Article, except include continuous waste for multi-bowl sinks.

- a. Disposer: Not required.
- b. Hot-Water Dispenser: Not required.

B. Sinks: S-2: counter mounted, stainless steel. See schedule for additional information.

1. Stainless-Steel Sinks:

a. Manufacturers: Elkay LRAD2219R or provide products by one of the following:

- 1) Just Manufacturing.
- 2) Franke Consumer Products, Inc.

2. Fixture:

- a. Standard: ANSI Z124.3 and ANSI/ICPA SS-1 for solid-surface kitchen sinks.
- b. Standard: ASME A112.19.3/CSA B45.4 for stainless-steel kitchen sinks.
- c. Overall Dimensions: See plumbing fixture schedule.
- d. Metal Thickness: 18 gauge.
- e. Bowl:

- 1) Dimensions: See plumbing fixture schedule
  - 2) Drain: 3-1/2-inch crumb cup or outlet for disposer.
    - a) Location: Rear-Centered in bowl location.
  3. Faucet: Comply with the requirements in "Sink Faucets" Article.
  4. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
  5. Waste Fittings: Comply with requirements in "Waste Fittings" Article, except include continuous waste for multi-bowl sinks.
    - a. Disposer: Not required.
    - b. Hot-Water Dispenser: Not required.
- C. Sinks: S-3: counter mounted, stainless steel. See schedule for additional information.
1. Stainless-Steel Sinks:
    - a. Manufacturers: Just SB-372 or provide products by one of the following:
      - 1) Elkay Manufacturing.
      - 2) Franke Consumer Products, Inc.
    2. Fixture:
      - a. Standard: ANSI Z124.3 and ANSI/ICPA SS-1 for solid-surface kitchen sinks.
      - b. Standard: ASME A112.19.3/CSA B45.4 for stainless-steel kitchen sinks.
      - c. Overall Dimensions: See plumbing fixture schedule.
      - d. Metal Thickness: 14 gauge.
      - e. Bowl:
        - 1) Dimensions: See plumbing fixture schedule
        - 2) Drain: 3-1/2-inch crumb cup or outlet for disposer.
          - a) Location: Rear-Centered in bowl location.
      3. Faucet: Comply with the requirements in "Sink Faucets" Article.
      4. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
      5. Waste Fittings: Comply with requirements in "Waste Fittings" Article, except include continuous waste for multi-bowl sinks.
        - a. Disposer: Not required.
        - b. Hot-Water Dispenser: Not required.

D.

## 2.7 SINK FAUCETS

- A. NSF Standard: Comply with NSF 372 for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets: S-1, Manual type, single control mixing valve.

1. General-Duty, Solid-Brass Faucets:

a. Manufacturers: Chicago Faucet 895-GN2BVBE2-2CP or provide products by one of the following:

- 1) Delta Faucet Company.
- 2) Zurn Industries, LLC.

2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
4. Body Type: Centerset.
5. Body Material: Commercial, solid brass.
6. Finish: Polished chrome plate.
7. Maximum Flow Rate: 1.5 gpm.
8. Handle(s): Lever.
9. Mounting Type: Back/wall, exposed.
10. Spout Type: Swing, solid brass.
11. Vacuum Breaker: Required.
12. Spout Outlet: Hose thread according to ASME B1.20.7.

C. Sink Faucets: S-2, Solid brass, kitchen sink.

1. General-Duty, Solid-Brass Faucets:

a. Manufacturers: Chicago Faucet 895-GN2BVBE2-2CP or provide products by one of the following:

- 1) Moen.
- 2) Delta Faucet Company.

2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
4. Kitchen Sink Option: Separate hand spray complying with ASSE 1025.
5. Finish: Polished chrome plate.
6. Maximum Flow Rate: 1.5 gpm unless otherwise indicated.
7. Mixing Valve: Two-lever handle.
8. Backflow-Prevention Device for Hand Spray: Required.
9. Centers: 8 inches or Adjustable.
10. Mounting: Deck, exposed.
11. Handle(s): Lever or Wrist blade, 4 inches.
12. Spout Type: Swing, solid brass] [Rigid gooseneck.
13. Spout Outlet: Swivel aerator/spray.
14. Drain: Grid or Lift and turn.

D. Sink Faucets: S-3, Solid brass, pre-rinse faucet.

1. General-Duty, Solid-Brass Faucets:
  - a. Manufacturers: Chicago 886-CP or provide products by one of the following:
    - 1) T&S Brass.
    - 2) Delta Faucet Company.
2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
4. Kitchen Sink Option: Separate hand spray complying with ASSE 1025.
5. Finish: Polished chrome plate.
6. Maximum Flow Rate: 1.5 gpm unless otherwise indicated.
7. Mixing Valve: Two-lever handle.
8. Backflow-Prevention Device for Hand Spray: Not Required.
9. Centers: 8 inches or Adjustable.
10. Mounting: Wall.
11. Handle(s): Lever or Wrist blade, 4 inches.
12. Spout Type: Swing, solid brass.
13. Spout Outlet: With vacuum breaker, swivel aerator/spray.
14. Drain: Grid or Lift and turn with continuous drain, solid interceptor. See interceptor section.

## 2.8 DISPOSERS

- A. General: Garbage disposers shall accommodate required knee and toe clearances per 2019 CBC 11B-606, 11B-306.2, and 11B-306.
- B. Disposers: Continuous-feed household, food waste.
  1. Continuous-Feed Disposers:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Franke Consumer Products, Inc.
      - 2) InSinkErator; a division of Emerson Electric Co.
      - 3) KitchenAid; a division of Whirlpool Corporation.
  2. Standards: ASSE 1008 and UL 430, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  3. General: Include reset button; wall switch; corrosion-resistant chamber with jam-resistant, cutlery- or stainless-steel grinder or shredder; NPS 1-1/2 outlet; quick-mounting, stainless-steel sink flange; antisplash guard; and combination cover/stopper.
  4. Model: Sound-insulated chamber and stainless-steel outer shell.
  5. Motor: See plumbing fixture schedule.



## **2.9 SUPPORTS**

### **A. Water Closet Carrier:**

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Zurn Industries, LLC.
  - b. JR Smith
  - c. Mifab
2. Standard: ASME A112.6.1M.
3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

## **2.10 SUPPLY FITTINGS**

- A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.
- F. Risers:
  1. Lavatories: NPS 3/8 Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces, ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.
  2. Sinks: NPS 1/2 Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces, ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

## **2.11 WASTE FITTINGS**

- A. Manufacturers: McGuire Pro-wrap series or approved equal.
- B. Standard: ASME A112.18.2/CSA B125.2.
- C. Drain: Grid type with NPS 1-1/4 or NPS 1-1/2 offset and straight tailpiece.
- D. Traps:

1. Lavatories: NPS 1-1/2 by 1-1/4.
  2. Sinks: NPS 1-1/2.
  3. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall and chrome-plated, brass or steel wall flange with integral insulation.
- E. Continuous Waste:
1. Size: NPS 1-1/2" or NPS 2".
  2. Material: Chrome-plated, 0.032-inch thick brass tube.

## **2.12 GROUT**

- A. Standard: ASTM C1107/C1107M, 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 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. General: Installation shall comply with the 2010 Americans with Disabilities Act (ADA) Design Standards and 2019 California Building Code (CBC).
- B. 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 accessible/elderly, according to the 2010 Americans with Disabilities Act (ADA) Design Standards and 2019 California Building Code (CBC).
- C. 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.

D. 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.

E. Install toilet seats on water closets.

F. 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 220518 "Escutcheons for Plumbing Piping."

G. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

### **3.3 CONNECTIONS**

- A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

**3.4 ADJUSTING**

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

**3.5 CLEANING AND PROTECTION**

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

**END OF SECTION 22 40 00**

## SECTION 23 00 00 – GENERAL MECHANICAL REQUIREMENTS

### 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 SCOPE

- A. Basic mechanical requirements specifically applicable to Division 23 and 33 Sections.
- B. Work includes but is not necessarily limited to the following:
  - 1. Labor, materials, services, equipment, and appliances required for completion of tasks as indicated on drawing or in specification or as inherently necessary to prepare spaces and systems for new installations as follows:
    - a. Heating, ventilating and air conditioning systems and equipment
    - b. Testing, adjusting and balancing

#### 1.3 DRAWINGS AND SPECIFICATIONS

- A. Drawings accompanying these Specifications show intent of Work to be done. Specifications shall identify quality and grade of installation and where equipment and hardware is not particularly specified, Contractor shall provide submittals for all products and install them per manufacturers' recommendations, and in a workmanlike manner.
- B. Examine Drawings and Specifications for elements in connection with this Work; determine existing and new general construction conditions and be familiar with all limitations caused by such conditions.
- C. Plans are intended to show general arrangement and extent of Work contemplated. Exact location and arrangement of parts shall be determined after the Owner has reviewed equipment, as Work progresses, to conform in best possible manner with surroundings, and as directed by the Owner's Representative.
- D. Contract Documents are in part diagrammatic and intended to show the scope and general arrangement of the Work under this Contract. The Contractor shall follow these drawings in laying out the equipment, piping and ductwork. Drawings are not intended to be scaled for roughing in measurements or to serve as shop drawings. Where job conditions require minor changes or adjustments in the indicated locations or arrangement of the Work, such changes shall be made without change in the Contract amount.

- E. Follow dimensions without regard to scale. Where no figures or notations are given, the Plans shall be followed.

#### **1.4 UTILITIES**

- A. Location and sizes of electrical, mechanical and plumbing service facilities are shown in accordance with data secured from existing record drawings and site observations. Data shown are offered as an estimating guide without guarantee of accuracy. Check and verify all data given, and verify exact location of all utility services pertaining to Work prior to excavation or performing Work.

#### **1.5 APPLICABLE REFERENCE STANDARDS, CODES AND REGULATIONS**

- A. Meet requirements of all state codes having jurisdiction.
- B. State of California Code of Regulations:
  - 1. Title 8, Industrial Relations
  - 2. Title 19, State Fire Marshal Regulations
  - 3. Current California Building Code (CBC), Title 24, Part 2
  - 4. Current California Electrical Code, Title 24, Part 3
  - 5. Current California Mechanical Code, Title 24, Part 4
  - 6. Current California Plumbing Code, Title 24, Part 5
  - 7. Current California Energy Code, Title 24, Part 6
  - 8. Current California Fire Code, Title 24, Part 9
  - 9. Current California Standards Code, Title 24, Part 12
- C. Additional Referenced Standards:
  - 1. AABC Associated Air Balance Council
  - 2. AMCA Air Moving and Conditioning Association
  - 3. AHRI Air-Conditioning, Heating and Refrigeration Institute
  - 4. ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers
  - 5. ASME American Society of Mechanical Engineers
  - 6. ASTM American Society for Testing and Materials
  - 7. NEMA National Electrical Manufacturer's Association
  - 8. NFPA National Fire Protection Association Standards
  - 9. PDI Plumbing and Drainage Institute
  - 10. UL Underwriters Laboratories
- D. Codes and ordinances having jurisdiction over Work are minimum requirements; but, if Contract Documents indicate requirements, which are in excess of those minimum requirements, then requirements of the Contract Documents shall be followed. Should there be any conflicts between Contract Documents or codes or any ordinances having jurisdiction, report these to the Owner's Representative.
- E. Obtain permits, and request inspections from authority having jurisdiction.

## **1.6 PROJECT AND SITE CONDITIONS**

- A. The arrangement of and connection to equipment shown on the Drawings is based upon information available and is not intended to show exact dimensions peculiar to a specific manufacturer. The Drawings are, in part, diagrammatic and some features of the illustrated equipment installations may require revision to meet actual equipment installation requirements. Structural supports, housekeeping pads, piping connections and adjacent equipment may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions or alterations.
- B. Examine all Drawings and Specifications to be fully cognizant of all work required under this Division.
- C. Examine site related work and surfaces before starting work of any Section.
- D. Install Work in locations shown on approved Drawings, unless prevented by Project conditions.
- E. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission from the Owner's Representative before proceeding.

## **1.7 COOPERATION WITH WORK UNDER OTHER DIVISIONS**

- A. Cooperate with other trades to facilitate general progress of Work. Allow all other trades every reasonable opportunity for installation of their work.
- B. Work under this Division shall follow general building construction closely. Set pipe sleeves and inserts and verify that openings for chases and pipes are provided.
- C. Work with other trades in determining exact location of outlets, pipes, and pieces of equipment to avoid interference with lines required to maintain proper installation of Work.
- D. Make such progress in the Work to not delay work of other trades.
- E. Mechanical Work shall have precedence over the other in the following sequence:
  - 1. Soil and waste piping
  - 2. Hydronic piping
  - 3. Ductwork
  - 4. Domestic water piping
  - 5. Fire sprinkler piping

## **1.8 DISCREPANCIES**

- A. The Contractor shall check all Drawings furnished him immediately upon their receipt and shall promptly notify the Owner's Representative of any discrepancies. Figures marked on Drawings shall in general be followed in preference to scale measurements. Piping and instrumentation

diagrams shall in general govern floor plans and sections. Large-scale drawings shall in general govern small-scale drawings.

- B. Where requirements between Drawings and Specifications conflict, the more restrictive provisions shall apply.
- C. If any part of the Specifications or Drawings appears unclear or contradictory, apply to Owner's Representative for interpretation and decision as early as possible, including during bidding period. Do not proceed with such work without Owner Representatives decision. Beginning work of any Section constitutes acceptance of conditions.

## 1.9 CHANGES

- A. The Contractor shall be responsible to make and obtain approval from the Owner's Representative for all necessary adjustments in piping and equipment layouts as required to accommodate the relocations of equipment and/or devices, which are affected by any approved authorized changes or Product substitutions. All changes shall be clearly indicated on the "Record" drawings.

## 1.10 SUBMITTALS

- A. Refer to Division 01 for additional requirements.
- B. The manufacturer, contractor or supplier shall include a written statement that the submitted equipment, hardware or accessory complies with the requirement of that particular specification section.
- C. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section.
- D. All **exceptions** shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- E. Note that prior to acceptance of submittals for review, a submittal schedule shall be submitted to the Owner's Representative.
- F. Submit all Division 23 shop drawings and product data grouped and referenced by the specification technical section number into a complete submittal package for each specification section.
- G. Shop Drawings:
  - 1. Include installation details of equipment indicating proposed location, layout and arrangement, accessories, piping, and other items that must be shown to assure a coordinated installation.
  - 2. Indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
  - 3. If equipment is rejected, revise drawings to show acceptable equipment and resubmit.



- H. Whenever more than one (1) manufacturer's product is specified, the first named product is the basis of design used in the Drawings and the use of alternate-named manufacturer's products or substitutes may require modifications to the design.
- I. The Contractor shall be responsible for all equipment ordered and/or installed prior to receipt of shop drawings returned from the Owner's Representative bearing the Owner's Representative stamp of "Reviewed". All corrections or modifications to the equipment as noted on the shop drawings shall be performed and equipment removed from the job site at the request of the Owner's Representative without additional compensation.
- J. **Manufacturer's Data:** For each manufactured item, provide current manufacturer's descriptive literature of cataloged products, certified equipment drawings, diagrams, performance and characteristic curves if applicable, and catalog cuts.
- K. **Standard Compliance:** When materials or equipment provided by the Contractor must conform to the standards of organizations such as American National Standards Institute (ANSI) or UL, submit proof of such conformance to the Owner Representative for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified. In lieu of the label or listing, submit a certificate from an independent testing organization, which is competent to perform acceptance testing and is approved by the Owner Representative. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard.
- L. **Certified Test Reports:** Before delivery of materials and equipment, certified copies of all test reports specified in individual sections shall be submitted for approval.
- M. **Certificates of Compliance or Conformance:** Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this Contract. Pre-printed certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; or "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance or conformance.

## 1.11 PROJECT RECORD DOCUMENTS

- A. Refer to Division 01 for additional requirements.
  - 1. All changes, deviations and information recorded on the "Project Record Drawings" set during Construction shall be redrafted onto the latest version of AutoCAD or Revit, where applicable.

2. Submit completed shop drawings to the Owner prior to completion in AutoCAD format. Contractor hand marked or drafted redlined "Project Record Drawings" will not be accepted.

#### **1.12 PRODUCT ALTERNATIVES OR SUBSTITUTIONS**

- A. Refer to General Conditions and Division 01 for additional requirements.

#### **1.13 OPERATING INSTRUCTIONS**

- A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation and maintenance personnel.

#### **1.14 MANUFACTURER'S RECOMMENDATIONS**

- A. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

#### **1.15 DELIVERY AND STORAGE**

- A. Refer to Division 01 for additional requirements.
- B. Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations and with the requirements of NFPA 70B P, Appendix I, titled "Equipment Storage and Maintenance During Construction." Replace damaged or defective items with new items.

#### **1.16 GUARANTEE**

- A. Except as may be specified under other sections in the Specifications, guarantee all equipment furnished under the Specifications for a period of one year from date of project acceptance against defective workmanship and material and improper installation. Upon notification of failure, correct deficiency immediately and without cost to the Owner.
- B. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the Owner for their service agency as directed.

### **PART 2 - PRODUCTS**

Not Applicable.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Obtain and pay for all permits and inspections, including any independent testing required to verify standard compliance, and deliver certificates for same to the Owner's Representative.

### **3.2 WORK RESPONSIBILITIES**

- A. The drawings indicate diagrammatically the desired locations or arrangement of piping, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference with structural conditions.
- B. The Contractor is responsible for the correct placing of Work and the proper location and connection of Work in relation to the work of other trades. Advise appropriate trade as to locations of access panels.
- C. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes shall be made without extra cost, providing the change is ordered before the ductwork, piping, etc. and work directly connected to same is installed and no extra materials are required.
- D. Where equipment is furnished by others, verify dimensions and the correct locations of this equipment before proceeding with the roughing-in of connections.
- E. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with any work, carefully check and verify all dimensions, sizes, etc. with the drawings to see that the equipment will fit into the spaces provided without violation of applicable codes.
- F. Should any changes to the Work indicated on the Drawings or described in the Specifications be necessary in order to comply with the above requirements, notify the Owner immediately and cease work on all parts of the contract, which are affected until approval for any required modifications to the construction has been obtained from the Owner.
- G. Be responsible for any cooperative work, which must be altered due to lack of proper supervision or failure to make proper provisions in time. Such changes shall be under direction of the Owner and shall be made to his satisfaction. Perform all Work with competent and skilled personnel.
- H. All work, including aesthetic as well as mechanical aspects of the Work, shall be of the highest quality consistent with the best practices of the trade.
- I. Replace or repair, without additional compensation, any Work, which, in the opinion of the Owner, does not comply with these requirements.

### **3.3 PAINTING**

- A. Refer to Division 09 for additional requirements.
- B. Factory Applied:
  - 1. Mechanical equipment shall have factory-applied painting systems, which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test, except equipment specified to meet requirements of ANSI C37.20 shall have a finish as specified in ANSI C37.20.
  - 2. Refer to individual sections of this Division for more stringent requirements.
- C. Field Applied:
  - 1. Paint all mechanical equipment as required to touch up, to match finish on other equipment in adjacent spaces or to meet safety criteria.
  - 2. Paint all exposed, uninsulated mechanical piping, valves, supports, hangers and appurtenances. Provide minimum 5 mils dry film thickness.
  - 3. Paint ductwork flat black that are visible behind air outlets and inlets.
  - 4. Paint all exposed and rooftop ductwork, roof mounted mechanical equipment, ductwork supports, hangers and appurtenances.
  - 5. Paint shall be a high performance polyurethane enamel coating system.
    - a. Acceptable paint manufacturers include Ameron, Tnemec or engineer approved equal.
    - b. Acceptable primer manufacturers include Ameron Amershield VOC, Tnemec's Series 1075 (1074) Endura-Shield, semi-gloss (gloss) sheen or equal.
    - c. Provide minimum 5 mils dry film thickness.

**END OF SECTION 23 00 00**

## SECTION 23 05 17 – SLEEVES AND SLEEVE SEALS 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. Sleeves.
  - 2. Stack-sleeve fittings.
  - 3. Sleeve-seal systems.
  - 4. Sleeve-seal fittings.
  - 5. Grout.
  - 6. Silicone sealants.
- B. Related Requirements:
  - 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall be formatted per Section 230000 "General Mechanical Requirements".
- B. Product Data: For each type of product.

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

## **2.2 SLEEVE-SEAL SYSTEMS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Thunderline Modular Seals; Link-Seal
  2. Advance Products & Systems, Inc.
  3. Calpico, Inc.
  4. Metraflex Co.
  5. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve. Designed to form a hydrostatic seal of 20-psi minimum.
  1. Sealing Elements: EPDM 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. Include two for each sealing element.
  3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.
  4. Link-Seal shall be basis of design.

## **2.3 GROUT**

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  2. Design Mix: 5000-psi, 28-day compressive strength.
  3. Packaging: Premixed and factory packaged.

## **PART 3 - EXECUTION**

### **3.1 SLEEVE INSTALLATION**

- A. Sleeves are not required for core-drilled holes, except where spill control is required
- B. Install sleeves for pipes passing through interior concrete and masonry walls, and concrete floor and roof slabs.
  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. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

- b. Exception: Extend sleeves installed in floors for areas indicated 4 inches above finished floor level, including slabs on grade.
    2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
    3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
      - a. Steel Pipe Sleeves: For mechanical rooms, and wet area applications where spill containment is required.
      - b. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
      - c. Seal space outside of sleeve fittings with grout.
    4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
    5. Where required, sleeve application and installation shall comply with UL approved Firestopping Detail.
  - C. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using 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.
    1. Install steel pipe for sleeves.
    2. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
  - D. Underground, Exterior-Wall Pipe Penetrations: Seal pipe penetrations using mechanical sleeve seals. Select penetration size to allow for 1-inch annular clear space between pipe and penetration for installing mechanical sleeve seals.
    1. Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.2 GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.

- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

### **3.3 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

**END OF SECTION 23 05 17**



## **SECTION 23 05 18 - 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. Submittals shall be formatted per Section 230000 "General Mechanical Requirements".
- B. Product Data: For each type of product.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Brasscraft Manufacturing Company
- B. The Keeney Manufacturing Company
- C. Mid-America Fittings, Inc.
- D. Or Approved Equal

#### **2.2 ESCUTCHEONS**

- A. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

### **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. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

#### **3.2 FIELD QUALITY CONTROL**

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

**END OF SECTION 23 05 18**

## **SECTION 23 05 19 – METERS AND GAUGES 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. Thermometers
  - 2. Thermowells
  - 3. Dial-type pressure gauges
  - 4. Gauge attachments
  - 5. Test plugs
  - 6. Test-plug kits
- B. Related Requirements:
  - 1. Section 232113 “Hydronic Piping”
  - 2. Section 232116 “Hydronic Piping Specialties”

#### **1.3 ACTION SUBMITTALS**

- A. Submittals shall be formatted per Section 230000 “General Mechanical Requirements”.
- B. Product Data: For each type of product indicated.
- C. Schedule: For thermometers, pressure gauges, thermowell and test plugs indicating manufacturer's number, scale range, and location for each.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Product Certificates: For each type of meter and gauge from manufacturer.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Select gauges such that the high limit of range does not exceed a factor of 1.5x the standard operating point for that particular system.
- B. Select gauges so that system operating pressure is found within the middle 1/3 of overall range.

### **2.2 DIAL THERMOMETERS**

- A. Manufacturers
  - 1. Ashcroft Commercial Inc.
  - 2. Marsh Bellofram
  - 3. Terice, H. O. Co.
  - 4. Weiss Instruments, Inc.
  - 5. Weksler Instruments Inc.
  - 6. 3D Instruments
  - 7. Or equal.
- B. Bimetallic-Actuated
  - 1. Description: Adjustable angle, Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.200.
  - 2. Case: Highly polished, hermetically sealed, stainless steel, 5-inch diameter.
  - 3. Element: Bimetal coil.
  - 4. Dial: Satin-faced, or highly polished, non-reflective aluminum with permanently etched scale markings.
  - 5. Pointer: Black metal.
  - 6. Window: Double strength Glass.
  - 7. Ring: Stainless steel.
  - 8. Connector: Adjustable angle, NPT ½ with ASME B1.1 screw threads.
  - 9. Stem: stainless steel, for thermo-well installation and of length to suit installation.
  - 10. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.
  - 11. Units: Scale shall be degrees Fahrenheit, unless otherwise indicated, suitable for the media operating temperatures.

### **2.3 THERMOWELLS**

- A. Manufacturers:
  - 1. Ashcroft Commercial Inc.
  - 2. Marsh Bellofram.
  - 3. Terice, H. O. Co.

4. Weiss Instruments, Inc.
5. 3D Instruments
6. Or equal.

B. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping.
3. Pressure Rating: Not less than piping system design pressure.
4. Material: stainless steel.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPT 1/2, NPT 3/4, or NPT 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: Extend one-third to two-thirds of pipe diameter into fluid.
10. Lagging Extension: Extension for Insulated Piping: 2 inches nominal and not less than thickness of insulation.
11. Bushings: are prohibited.

C. Heat-Transfer Medium: Mixture of graphite and glycerin.

## 2.4 PRESSURE GAUGES

A. Manufacturers:

1. Ashcroft Commercial Inc.
2. Marsh Bellofram.
3. Terrice, H. O. Co.
4. Weiss Instruments, Inc.
5. 3D Instruments.
6. Or equal.

B. Direct-Mounting, Dial-Type Pressure Gauges: Indicating-dial type complying with ASME B40.100.

1. Case: Liquid-fillable type, 4.5-inch diameter Grade-A phosphor Bronze or stainless steel.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, or stainless steel, NPT 1/4, or 1/2, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, direct drive or with link to pressure element and connection to pointer.
5. Dial: Satin-faced, non-reflective aluminum with permanently etched scale markings.
6. Pointer: Black metal.
7. Window: Glass.
8. Ring: Stainless steel.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

12. Scale: Scale shall be psig, inches mercury vacuum, combination of those two depending on the application.
13. Units: PSI only. Dual unit gauges (e.g. kPa and PSI) are prohibited.

## **2.5 GAUGE ATTACHMENTS**

- A. Snubbers: ASME B40.100, 303 stainless steel; with NPT 1/4 or NPA 1/2, ASME B1.20.1 pipe threads and surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of stainless-steel pipe with threaded ends.
- C. Valves: NPT ¼ or ½ stainless-steel threaded ball valve type.

## **2.6 TEST PLUGS**

- A. Manufacturers:
  1. Peterson Equipment Co., Inc.
  2. Sisco Manufacturing Co.
  3. IMI Hydronic Engineering (Flow Design), Inc.
  4. Or equal.
- B. Description: Corrosion-resistant brass or stainless-steel body with minimum two core inserts and gasketed and threaded cap with cap retainer, with extended stem beyond insulation for units to be installed in insulated piping.
- C. Thread Size: NPT 1/2, ASME B1.20.1 pipe thread.
- D. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- E. Core Inserts: Two chlorosulfonated (CR) polyethylene synthetic and EPDM (Nordel) self-sealing rubber, valves gasketed orifice, suitable for inserting a 1/8" OD probe assembly.
  1. Insert material for air, water (except for water heated by high temperature water), oil, or gas service at 20 to 200 deg F shall be CR.
  2. Insert material for air or high temperature water heated hot water service at 30 to plus 275 deg F shall be EPDM.
- F. If test plug requires probes longer than 1-inch, provide to the Owner three probes of the required length for the installed test plug.

## **2.7 TEST-PLUG KITS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Peterson Equipment Co., Inc.
  2. Sisco Manufacturing Co.

3. IMI Hydronic Engineering (Flow Design), Inc.
  4. Or equal.
- B. Furnish one test-plug kit containing two thermometers, one pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer: Small, bimetallic insertion type with 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.
- D. High-Range Thermometer: Small, bimetallic insertion type with 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.
- E. Pressure Gauge: Small, Bourdon-tube insertion type with 3-inch-diameter dial and probe. Dial range shall be at least 0 to 200 psig.
- F. Carrying Case: Metal or plastic, with formed instrument padding.

### **PART 3 - EXECUTION**

#### **3.1 THERMOMETER APPLICATIONS**

- A. Install bimetallic-actuated dial thermometers in the following locations:
1. Inlet and outlet of each hydronic zone.
  2. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
- B. Subject to listed standard ranges from the approved manufacturer, provide the following temperature ranges for thermometers:
1. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
  2. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions.

#### **3.2 GAUGE APPLICATIONS**

- A. Install dry-case-type pressure gauges for inlet and discharge of each pressure-reducing valve.
- B. Install dry-case-type pressure gauges at chilled- and condenser-water inlets and outlets of chillers.
- C. Install liquid-filled-case-type pressure gauges at suction and discharge of each pump.
- D. Subject to listed standard ranges from the approved manufacturer, provide the following pressure ranges for the gauges:
1. Heating Hot Water Piping: 0 to 200 psi.
  2. Chilled Water Piping: 0 to 200 psi.

### 3.3 INSTALLATION

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending a minimum of 2 inches into fluid or to the center of pipe and in vertical position in piping tees where thermometers are indicated.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounting pressure gauges in piping tees with pressure gauge located on pipe at most readable position.
- F. Install ball valve in piping for each pressure gauge for fluids (except steam). Install snubber fitting in piping for each pressure gauge for pumps.
- G. Install ½-inch forged steel globe valve and syphon fitting in piping for each pressure gauge for steam see campus standard detail.
- H. Install test plugs in tees in piping.
- I. Install sight flow indicators, in accessible positions for easy viewing, in piping systems.
- J. Assemble and install connections, tubing, and accessories between flow-measuring elements as prescribed by manufacturer's written instructions.
- K. Install permanent indicators on walls or brackets in accessible and readable positions.
- L. Install connection fittings for attachment to portable indicators in accessible locations.

### 3.4 CONNECTIONS

- A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance for meters, gauges, machines, and equipment.

### 3.5 ADJUSTING

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gauges to proper angle for best visibility.

### 3.6 CLEANING

- A. Clean windows of meters, and gauges, and factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touch-up paint.



**P2S Inc.**  
005.2882.000

January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

**END OF SECTION 23 05 19**

**P2S Inc.**  
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January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

## SECTION 23 05 23 – GENERAL DUTY VALVES 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. Bronze ball valves.
2. Iron, single-flange butterfly valves.
3. Bronze swing check valves.
4. Iron, center-guided check valves.
5. Iron gate valves.
6. Bronze globe valves
7. Chainwheels.

- B. Related Sections:

1. Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

#### 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.

#### 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.

## 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 gate and globe valves closed to prevent rattling.
  4. Set ball valves open to minimize exposure of functional surfaces.
  5. Set butterfly valves closed or slightly open.
- 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. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
1. ASME B1.20.1 for threads for threaded-end valves.
  2. ASME B16.1 for flanges on iron valves.
  3. ASME B16.5 for flanges on steel valves.
  4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  5. Caution: Use solder with melting point below 421 deg F.
  6. ASME B16.18 for solder-joint connections.
  7. ASME B31.1 for power piping valves.
  8. ASME B31.9 for building services piping valves.
- C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- D. HVAC ball valve applications specified in this Section are limited to NPS 10.

- E. Refer to HVAC valve schedule articles for applications of valves.
- F. Caution: Revise pressure ratings and insert temperature ratings in valve articles if valves with higher ratings are required.
- G. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- H. Valve Sizes: Same as upstream piping unless otherwise indicated.
- I. Valve Actuator Types:
  - 1. Handlever: For quarter-turn valves smaller than NPS 4.
- J. Valves in Insulated Piping:
  - 1. Include 2-inch stem extensions.
  - 2. Extended operating handle of nonthermal-conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.
  - 3. Memory stops that are fully adjustable after insulation is applied.
- K. Valve Bypass and Drain Connections: MSS SP-45.

## **2.2 BRONZE BALL VALVES (SIZES ½” THROUGH 2”)**

- A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Milwaukee Valve Company.
    - b. NIBCO INC.
    - c. Watts Regulator Co.
  - 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: Stainless steel.
    - i. Ball: Stainless steel, vented.
    - j. Port: Full.

### **2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES (SIZES 2-1/2" THROUGH 12")**

- 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. Milwaukee Valve Company.
    - c. NIBCO 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 or ductile iron.

### **2.4 BRONZE SWING CHECK VALVES**

- A. Bronze Swing Check Valves with Bronze Disc, Class 150:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane Co.; Crane Valve Group; Crane Valves.
    - b. Milwaukee Valve Company.
    - c. NIBCO INC
    - d. Conbraco Industries, Inc; Apollo Division
  2. Description:
    - a. Standard: MSS SP-80, Type 3.
    - b. CWP Rating: 300 psig.
    - c. Body Design: Horizontal flow.
    - d. Body Material: ASTM B 62, bronze.
    - e. Ends: Threaded.
    - f. Disc: Bronze.

### **2.5 IRON, CENTER-GUIDED CHECK VALVES**

- A. Iron, Globe, Center-Guided Check Valves with Resilient Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Milwaukee Valve Company.
  - b. NIBCO INC.
2. Description:
  - a. Standard: MSS SP-125.
  - 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 A126, cast iron.
  - e. Style: Globe, spring loaded.
  - f. Ends: Flanged.
  - g. Seat: EPDM.

## **2.6 IRON GATE VALVES**

### **A. Iron Gate Valves, OS&Y, Class 125:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Stockham Division.
  - b. Milwaukee Valve Company.
  - c. Powell Valves.
  - d. Hammond Valve.
  - e. NIBCO 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.

## **2.7 CHAINWHEELS**

- ### **A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
1. Roto Hammer Industries.
  2. 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 ball and 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 ball and butterfly valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

#### **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 or Ball
  4. Pump-Discharge Check Valves:
    - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
    - b. NPS 2-1/2 and Larger: Iron globe, center-guided, resilient-seat check valves.
- 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 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
1. Bronze Ball Valves: Two piece, full port, stainless-steel trim.
- B. Pipe NPS 2-1/2 and Larger:
1. Iron, Single-Flange Butterfly Valves: Aluminum-bronze disc, 200 CWP, EPDM seat.
  2. For underground valve box applications:
    - a. Butterfly Valves: Class 150, single flange

### 3.6 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
1. Bronze Ball Valves: Two piece, full port, stainless-steel trim.
- B. Pipe NPS 2-1/2 and Larger:
1. Iron, Single-Flange Butterfly Valves: Aluminum-bronze disc, 200 CWP, EPDM seat.
  2. For underground valve box applications:

- a. Butterfly Valves: Class 150, single flange

**END OF SECTION 23 05 23**

## **SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:

1. 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. Equipment supports.

- B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230548 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
3. Section 233113 "Metal Ducts" for duct hangers and supports.

#### **1.3 REFERENCES**

- A. ASME B31.9 Building Services Piping
- B. MSS SP58 Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application and installation
- C. MSS SP-69 Pipe Hangers and Supports – Selection and Application
- D. MSS SP-89 Pipe Hangers and Supports – Fabrication and Installation Practices

#### **1.4 DEFINITIONS**

- A. ASCE: American Society of Civil Engineers
- B. ASME: American Society of Mechanical Engineers

- C. ASTM: America Society for Testing and Material
- D. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.
- E. MFMA: Metal Framing Manufacturers Association
- F. SEI: Structural Engineering Institute

### **1.5 ACTION SUBMITTALS**

- A. Submittals shall be formatted per Section 230000 "General Mechanical Requirements".
- B. Product Data: For each type of product indicated including component cut sheets and pre-approved details.
- C. Delegated Design Submittal: Shop drawings signed and sealed by a qualified professional engineer. 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 current ASME Boiler and Pressure Vessel Code.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

## **2.2 METAL PIPE HANGERS AND SUPPORTS**

### **A. Carbon-Steel Pipe Hangers and Supports:**

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized 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 stainless steel.

## **2.3 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.

## **2.4 METAL FRAMING SYSTEMS**

### **A. MFMA Manufacturer Metal Framing Systems:**

1. Description: Shop or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: MFMA-4.
3. Channels: Continuous slotted steel channel with in-turned lips.
4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
6. Metallic Coating: Electroplated zinc, Mill galvanized, In-line, hot galvanized or Mechanically-deposited zinc.

### **B. Non-MFMA Manufacturer Metal Framing Systems:**

1. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4.
3. Channels: Continuous slotted steel channel with in-turned lips.
4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of PVC coated carbon steel, hot dipped galvanized carbon steel or stainless steel.

## **2.5 VERTICAL RISER CLAMPS FOR INSULATED PIPES**

### **A. Vertical Riser Clamps for Insulated Steel Pipes:**

1. Manufacturer shall be Pipe Shields Inc. Model E2100 or equal.
2. Carbon steel pipe material, steel straps and base that is compliance with ASTM A36.
3. Insulation shall be calcium silicate, asbestos free, treated with water repellent.
4. Jacket shall be galvanized steel that is in compliance with ASTM A-527.
5. Fasteners shall comply with ASTM A-307 plated.
6. Coating shall be primer coated.

### **B. Vertical Riser Clamps for Insulated Copper Pipes:**

1. Manufacturer shall be Hydra-Zorb Titan Riser Clamp or equal.
2. 25/50 flame spread/smoke spread index.
3. Eliminates insulation compression.
4. Crush resistant.
5. Vertical load rating up to 2400 lbs.

## **2.6 THERMAL-HANGER SHIELD INSERTS**

### **A. Manufacturers**

1. Pipe Shields Inc.
2. Pittsburg Corning Foamglas ONE
3. ITW Insulation Systems TRYMER 2000 XP

**B. Cold Piping: Insulation-Insert Material - 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. Hot Piping: Insulation-Insert Material - Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.**

**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.

## **2.7 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, stainless 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.

## **2.8 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 stainless-steel 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: Stainless steel.
  - 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-Mounted-Type Pipe Stands: Shop or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

## 2.9 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.10 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, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Non-staining, 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 077200 "Roof Accessories" for curbs.
- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- 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.
5. 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.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### **3.3 METAL FABRICATIONS**

- A. Cut, drill, and fit miscellaneous metal fabrications for 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 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099600 "High Performance Coatings."
- 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. Copper Pipe or Tubing
  - 1. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
  - 2. Or use padded hangers for piping that is subject to scratching.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.

7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- I. 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 non-insulated pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of non-insulated pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
  3. Insulated piping shall use vertical riser clamps for insulated pipe.
- J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment, up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- L. 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.
- M. 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.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

**END OF SECTION 23 05 29**

## **SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Elastomeric hangers.
10. Spring hangers.
11. Snubbers.
12. Restraint channel bracings.
13. Restraint cables.
14. Seismic-restraint accessories.
15. Mechanical anchor bolts.
16. Adhesive anchor bolts.
17. Vibration isolation equipment bases.

- B. Related Requirements:

1. Section 210548 "Vibration and Seismic Controls for Fire Suppression" for devices for fire-suppression equipment and systems.
2. Section 220548 "Vibration and Seismic Controls for Plumbing" for devices for plumbing equipment and systems.

#### **1.3 DEFINITIONS**

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning & Development.

#### **1.4 ACTION SUBMITTALS**

- A. Submittals shall be formatted per Section 230000 “General Mechanical Requirements”.
- B. Product Data: For each type of product.
  - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
  - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
    - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
    - b. Annotate to indicate application of each product submitted and compliance with requirements.
  - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- C. Shop Drawings:
  - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
  - 2. 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.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control reports.

#### **1.6 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: 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 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 and shall bear anchorage preapproval OPM number from OSHPD, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Seismic-Restraint Loading:
  - 1. Contractor shall consult on requirements with Structural Engineer of Record or other acceptable qualified engineer by the authority having jurisdiction.

### **2.2 ELASTOMERIC ISOLATION PADS**

- A. Elastomeric Isolation Pads.
  - 1. Manufacturer and Model:
    - a. Basis of Design
      - 1) Mason Industries Type MBSW
    - b. Or Approved Equal by:
      - 1) California Dynamics Corporation
      - 2) Kinetics Noise Control
      - 3) Vibrex
      - 4) Isotech Industries
  - 2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
  - 3. Size: Factory or field cut to match requirements of supported equipment.
  - 4. Pad Material: Oil and water resistant with elastomeric properties.
  - 5. Surface Pattern: Waffle pattern.
  - 6. Load-bearing metal plates adhered to pads.
  - 7. Sandwich-Core Material: Resilient and elastomeric

### **2.3 ELASTOMERIC ISOLATION MOUNTS**

#### **A. Double-Deflection, Elastomeric Isolation Mounts.**

1. Manufacturer and Model:
  - a. Basis of Design
    - 1) Mason Industries Type ND
  - b. Or Approved Equal by:
    - 1) California Dynamics Corporation
    - 2) Kinetics Noise Control
    - 3) Vibrex
    - 4) Isotech Industries
2. Mounting Plates:
  - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
  - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

### **2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS**

#### **A. Restrained Elastomeric Isolation Mounts.**

1. Manufacturer and Model:
  - a. Basis of Design
    - 1) Mason Industries Type BR
  - b. Or Approved Equal by:
    - 1) California Dynamics Corporation
    - 2) Kinetics Noise Control
    - 3) Vibrex
    - 4) Isotech Industries
2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

- a. Housing: Cast-ductile iron or welded steel.
- b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## **2.5 OPEN-SPRING ISOLATORS**

### **A. Freestanding, Laterally Stable, Open-Spring Isolators.**

#### **1. Manufacturer and Model:**

- a. Basis of Design
  - 1) Mason Industries Type SLFH
- b. Or Approved Equal by:
  - 1) California Dynamics Corporation
  - 2) Kinetics Noise Control
  - 3) Vibrex
  - 4) Isotech Industries

- 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
- 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
- 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
- 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- 6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
- 7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

## **2.6 HOUSED-SPRING ISOLATORS**

### **A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing.**

#### **1. Manufacturer and Model:**

- a. Basis of Design
  - 1) Mason Industries Type C
- b. Or Approved Equal by:
  - 1) California Dynamics Corporation
  - 2) Kinetics Noise Control
  - 3) Vibrex
  - 4) Isotech Industries

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
  - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
  - b. Top housing with attachment and leveling bolt, threaded mounting holes and internal leveling device.

## 2.7 RESTRAINED-SPRING ISOLATORS

### A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint.

1. Manufacturer and Model:
  - a. Basis of Design
    - 1) Mason Industries Type SLR
  - b. Or Approved Equal by:
    - 1) California Dynamics Corporation
    - 2) Kinetics Noise Control
    - 3) Vibrex
    - 4) Isotech Industries
2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
  - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
  - b. Top plate with threaded mounting holes and elastomeric pad.
  - c. Internal leveling bolt that acts as blocking during installation.
3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## 2.8 HOUSED-RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing.
1. Manufacturer and Model:
    - a. Basis of Design
      - 1) Mason Industries Type SSLFH
    - b. Or Approved Equal by:
      - 1) California Dynamics Corporation
      - 2) Kinetics Noise Control
      - 3) Vibrex
      - 4) Isotech Industries
  2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
    - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
  3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## 2.9 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
1. Manufacturer and Model:
    - a. Basis of Design
      - 1) Mason Industries Type SSLFH
    - b. Or Approved Equal by:
      - 1) California Dynamics Corporation
      - 2) Kinetics Noise Control

- 3) Vibrex
  - 4) Isotech Industries
2. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
  3. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

## **2.10 ELASTOMERIC HANGERS**

### **A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods.**

1. Manufacturer and Model:
  - a. Basis of Design
    - 1) Mason Industries Type HD
  - b. Or Approved Equal by:
    - 1) California Dynamics Corporation
    - 2) Kinetics Noise Control
    - 3) Vibrex
    - 4) Isotech Industries
2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

## **2.11 SPRING HANGERS**

### **A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression.**

1. Manufacturer and Model:
  - a. Basis of Design
    - 1) Mason Industries Type 30N OR PC30NS
  - b. Or Approved Equal by:
    - 1) California Dynamics Corporation
    - 2) Kinetics Noise Control
    - 3) Vibrex
    - 4) Isotech Industries

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

## **2.12 SNUBBERS**

### **A. Manufacturer and Model:**

1. Basis of Design
  - a. Mason Industries Type Z-1011
2. Or Approved Equal by:
  - a. California Dynamics Corporation
  - b. Kinetics Noise Control
  - c. Vibrex
  - d. Isotech Industries

### **B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.**

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.

## **2.13 RESTRAINT CHANNEL BRACINGS**

### **A. Manufacturer and Model:**

1. Basis of Design
  - a. Mason Industries Type Seismic Sway Bracing System
2. Or Approved Equal by:
  - a. California Dynamics Corporation
  - b. Kinetics Noise Control

- c. Vibrex
- d. Isotech Industries

- B. 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 and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

## **2.14 RESTRAINT CABLES**

- A. Manufacturer and Model:

- 1. Basis of Design

- a. Mason Industries Type SCBA Assembly, SCR, UC & CCB

- 2. Or Approved Equal by:

- a. California Dynamics Corporation
- b. Kinetics Noise Control
- c. Vibrex
- d. Isotech Industries

- B. Restraint Cables: ASTM A 603 galvanized ASTM A 492 stainless-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.

## **2.15 SEISMIC-RESTRAINT ACCESSORIES**

- A. Manufacturer and Model:

- 1. Basis of Design

- a. Mason Industries Type SCR, UC & CCB

- 2. Or Approved Equal by:

- a. California Dynamics Corporation
- b. Kinetics Noise Control
- c. Vibrex
- d. Isotech Industries

- B. Hanger-Rod Stiffener: Reinforcing steel angle clamped to hanger rod.

- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

- D. 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.



- E. 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.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

## **2.16 MECHANICAL ANCHOR BOLTS**

- A. Manufacturer and Model:
  - 1. Basis of Design
    - a. Mason Industries Type SAB/SAS
  - 2. Or Approved Equal by:
    - a. California Dynamics Corporation
    - b. Kinetics Noise Control
    - c. Hilti
- B. 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 E 488.

## **2.17 ADHESIVE ANCHOR BOLTS**

- A. Manufacturer and Model:
  - 1. Basis of Design
    - a. Mason Industries Type SAA
  - 2. Or Approved Equal by:
    - a. California Dynamics Corporation
    - b. Kinetics Noise Control
    - c. Hilti
- B. 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 E 488.

## **2.18 VIBRATION ISOLATION EQUIPMENT BASES**

- A. Steel Rails: Factory-fabricated, welded, structural-steel rails.

1. Manufacturer and Model:
    - a. Basis of Design
      - 1) Mason Industries Type RND Rails
    - b. Or Approved Equal by:
      - 1) California Dynamics Corporation
      - 2) Kinetics Noise Control
      - 3) Vibrex
      - 4) Isotech Industries
  2. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.
    - a. Include supports for suction and discharge elbows for pumps.
  3. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Rails shall have shape to accommodate supported equipment.
  4. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- B. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
1. Manufacturer and Model:
    - a. Basis of Design
      - 1) Mason Industries Type MSL
    - b. Or Approved Equal by:
      - 1) California Dynamics Corporation
      - 2) Kinetics Noise Control
      - 3) Vibrex
      - 4) Isotech Industries
  2. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
    - a. Include supports for suction and discharge elbows for pumps.
    - b. Provide sloped roof curb where noted on drawings.
    - c. Provide vibration isolation curb with 2" deflection where noted on drawings.
  3. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

4. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Concrete Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
1. Manufacturer and Model:
    - a. Basis of Design
      - 1) Mason Industries Type BMK
    - b. Or Approved Equal by:
      - 1) California Dynamics Corporation
      - 2) Kinetics Noise Control
      - 3) Vibrex
      - 4) Isotech Industries
  2. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
    - a. Include supports for suction and discharge elbows for pumps.
  3. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
  4. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
  5. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

## **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 of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 APPLICATIONS**

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- 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 due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

### **3.3 VIBRATION CONTROL AND 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 033000 "Cast-in-Place Concrete" and Section 033053 "Miscellaneous Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- D. Equipment Restraints:
  - 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
  - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
  - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- E. Piping Restraints:
  - 1. Comply with requirements in MSS SP-127.
  - 2. Space lateral supports a maximum of 40 feet o.c, and longitudinal supports a maximum of 80 feet o.c.
  - 3. Brace a change of direction longer than 12 feet.
- F. Install cables so they do not bend across edges of adjacent equipment or building structure.
- G. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

- H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- I. 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.
- J. 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.
- K. 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 piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 232113 "Hydronic Piping" for piping flexible connections.

### **3.5 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. 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 Structural Engineer of Record.
  5. Test to 90 percent of rated proof load of device.
  6. Measure isolator restraint clearance.
  7. Measure isolator deflection.
  8. Verify snubber minimum clearances.
9. Test and adjust restrained-air-spring isolator controls and safeties.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

### 3.6 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

### 3.7 VIBRATION ISOLATION EQUIPMENT BASES 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 033000 "Cast-in-Place Concrete" and Section 033053 "Miscellaneous Cast-in-Place Concrete."

### 3.8 VIBRATION ISOLATION SCHEDULE

Mechanical Equipment (Note 1)	Isolator Type	Min. Isolator Design Static Deflection, Inches	Seismic Restraint (Notes 2 and 3)
AHU-1	None (internally isolated)	N/A	-
AHU-2 thru AHU-7	Vibration isolation curbs	1	-
EF-1	None	N/A	-
EF-2, EF-3	Vibration isolation base	1	-

**SEISMIC RESTRAINT NOTES:**

1. Verify with the equipment manufacturer that the factory supplied equipment base can accommodate point loading from vibration isolators without deformation. If the unit base is unable to be point loaded, a supplemental steel base frame will required between the equipment and vibration isolators.
2. Where seismically restrained spring mounts with vertical travel limit stops are specified, additional seismic restraints are not required if a Licensed Structural Engineer verifies that limit stop on the seismically restrained mounts will provide sufficient seismic restraint that conforms to local Code requirements.
3. Submit seismic restraint calculations to the structural engineer of record for all connections of equipment to support structure for review and approval.

**END OF SECTION 23 05 48**

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## SECTION 23 05 49 – VARIABLE FREQUENCY DRIVES

### 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 separately enclosed, pre-assembled, combination variable frequency drives (VFD), rated 600 V and less, solid-state, PWM, for speed control of poly-phase, squirrel-cage induction motors.
- B. Related Sections:
  - 1. Section 230548 “Vibration and Seismic Control for HVAC”

#### 1.3 DEFINITIONS

- A. Factory-Installed VFD: A VFD installed by motorized-equipment manufacturer as a component of equipment.
- B. Field-Installed VFD: A VFD installed at project site. VFDs shipped with motorized-equipment but installed at project site shall be considered Field-Installed VFDs.
- C. Legend:
  - 1. BAS: Building Automation System.
  - 2. EMI: Electromagnetic Interface.
  - 3. IBC: International Building Code
  - 4. ICC-ES: ICC-Evaluation Service
  - 5. IGBT: Insulated-Gate Bipolar Transistor.
  - 6. LAN: Local Area Network.
  - 7. LED: Light-Emitting Diode.
  - 8. MCP: Motor-Circuit Protector.
  - 9. NC: Normally Closed.
  - 10. NO: Normally Open.
  - 11. OCPD: Overcurrent Protective Device.
  - 12. OSHPD: Office of Statewide Health Planning & Development (for the State of California).
  - 13. PID: Control Action, Proportional Plus Integral Plus Derivative.
  - 14. PWM: Pulse-Width Modulation.
  - 15. TDD: Total Demand (harmonic current) Distortion.
  - 16. THD(V): Total Harmonic Voltage Demand.

17. VFD: Variable Frequency Drive.

#### 1.4 ACTION SUBMITTALS

- A. Submittals shall be formatted per Section 230000 "General Mechanical Requirements".
- B. Product Data for each type of VFD
  - 1. For each type and rating of VFD indicated, include features, performance, electrical ratings, operating characteristics, location of wiring terminations, conduit entry and ground lug locations, shipping and operating weights, and furnished specialties and accessories.
- C. Shop Drawings
  - 1. For each VFD indicated, include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.
  - 2. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Each installed VFD's type and details.
    - b. Factory-installed devices.
    - c. Enclosure types and details.
    - d. Nameplate legends.
    - e. Short-circuit current (withstand) rating of enclosure unit.
    - f. Features, characteristics, ratings, and factory settings of each VFD and installed devices.
    - g. Specified Modifications.
  - 3. Schematic and Connection Wiring Diagrams for power, signal, and control wiring.
- D. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFDs where pipe and ducts are prohibited. Show VFD layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- E. Manufacturer Seismic Qualification Certification: Submit certification that VFDs, accessories, and components will withstand seismic forces defined in Section 230548 "Vibration and Supports for HVAC." Include the following:
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - 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."

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.
- F. Qualification Data: For manufacturer and testing agency.
- G. Test Report: Field quality-control test reports.

### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance data: For VFDs to include in emergency, operation, and maintenance manuals.
1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.
  2. Manufacturer's written instructions for setting field-adjustable overload relays.
  3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
  4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

### **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. Power Fuses: equal to 10 percent of quantity installed for each size and type, but no fewer than three 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. Indicating Lights: Two of each type and color installed.
  4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
  5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

### **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualification: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, and is a member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Person currently certified by NETA to supervise on-site testing.

- 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. Source Limitations: Obtain factory and field-installed VFD's of a single type through one source from a single manufacturer.
- E. VFD's and options shall be UL listed as a complete assembly. The base VFD shall be UL listed for 100 KAIC without the need for input fuses.

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

- A. Deliver VFD's in shipping splits of lengths that can be moved past obstructions in delivery path.
- B. Store VFDs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFDs from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- C. If stored in space that is not permanently enclosed and air conditioned
  - 1. Cover VFDs to protect them from weather, dirt, dust, corrosive substances, and physical damage.
  - 2. Remove loose packing and flammable materials from inside controllers.
  - 3. Install electric heating of sufficient wattage to prevent condensation.

## **1.9 PROJECT CONDITIONS**

- A. Environmental/Service Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions unless otherwise indicated:
  - 1. Ambient temperature, 32 to 105°F.
  - 2. Ambient Storage Temperature: Not less than minus 4°F and not exceeding 140°F.
  - 3. 0% to 95% relative humidity, non-condensing.
  - 4. Elevation: Not exceeding 3,300 feet without derating.
  - 5. AC line voltage variation, -35% to +30% of nominal.
- B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by the 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 the Owner's Representative no fewer than three weeks in advance of proposed interruption of electrical systems.
  - 2. Indicate method of providing temporary electrical service.
  - 3. Do not proceed with interruption of electrical systems with the Owner's Representative's written permission.
  - 4. Comply with NFPA-70E.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFDs, including clearances between VFDS, and adjacent surfaces and other items.

## 1.10 COORDINATION

- A. Coordinate the features of motors, load characteristics, installed units, and accessory devices of each VFD to be compatible with the following:
  - 1. Torque, speed, and horsepower requirements of the load.
  - 2. Designed and labeled for use with each motor throughout speed range without overheating
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.
- B. Coordinate layout and installation of VFDs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- C. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."
- D. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."
- E. Provide comprehensive commission of mechanical systems in accordance with Division 23 Section 230800 "Commissioning of HVAC" and as specified elsewhere in these Specifications. This includes cooperation and assistance with the Commissioning Authority to provide fully commissioned systems. Review the commissioning requirements of the project and provide support as required.

## 1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFDs that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of start-up.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

- A. ABB
- B. Danfoss
- C. Or Approved Equal

### 2.2 GENERAL

- A. VFD's serving mechanical equipment shall be provided from one manufacturer.

- B. Furnish complete variable frequency drives as specified herein for the equipment designated as variable speed.
  - 1. All standard and optional features shall be included within the VFD enclosure, unless otherwise specified.
  - 2. Include inlet air filters.
  - 3. Interior VFD enclosure shall be ventilated and have NEMA 12 rating, unless otherwise specified
  - 4. Exterior VFD enclosure shall be ventilated and have NEMA 3R rating, unless otherwise specified.
- C. The VFD shall convert three-phase, 60 Hz utility power to adjustable voltage and frequency, three-phase power for stepless motor speed control from 10% to 100% of the motor's 60 Hz speed. Input voltage shall be as specified on the drawing schedules.
- D. The VFD shall include a converter and an inverter section. The converter section shall convert fixed frequency and voltage AC utility power to DC voltage. The inverter section of the VFD shall invert the DC voltage into a quality output waveform, with adjustable voltage and frequency for stepless motor speed control. The VFD shall maintain a constant V/Hz ratio
- E. The VFD and options shall be tested to ANSI/UL Standard 508. The complete drive, including all specified options, shall be UL or ETL listed.
- F. Power line noise shall be limited to a voltage distortion factor and line notch depth as defined in IEEE Standard 519-2014, IEEE Recommended Practice and Requirements for Harmonic Control in Electrical Power Systems. The total voltage distortion shall not exceed 5%.
- G. PWM type drives shall include EMI/RFI filters that meet EN61800-3 for First Environment restricted level.
- H. Motor noise as a result of the VFD shall be limited to three dB across the line operation, measured at three feet from the motor's center line.
- I. The VFD's full load amp rating shall meet or exceed NEC Table 430-150.
- J. Protective Features:
  - 1. Individual motor overload protection for each motor controlled.
  - 2. Protection against input power undervoltage, overvoltage, and phase loss.
  - 3. Protection against output current overload and instantaneous over current.
  - 4. Protection against exceeding temperature limits within VFD enclosure.
  - 5. Protection against overvoltage on the DC bus.
  - 6. Protect VFD from sustained power or phase loss. Undervoltage trip activates automatically when line voltage drops more than 10% below rated input voltage.
  - 7. Automatically reset faults due to undervoltage, overvoltage, phase loss, or exceeding temperature limits.
  - 8. Protection against output short circuit and motor winding shorting to case faults, as defined by UL 508.
  - 9. Status lights or digital display for indication of individual fault conditions.

10. Controller capable of operating without a motor or any other equipment connected to the drive output to facilitate start-up and troubleshooting.
11. The VFD shall have a dual 5% impedance DC link reactor on the positive and negative rails of the DC buss to minimize power line harmonics and protect the VFD from power line transients.
  - a. The chokes shall be non-saturating. Swinging chokes that do not provide full harmonic filtering throughout the entire range are not acceptable.
  - b. VFDs with saturating (non-linear) DC link reactors shall require an additional 3% AC line reactor to provide acceptable harmonic performance at full load, where harmonic performance is most critical.

**K. Interface Features**

1. Door mounted Hand/Off/Auto selector switch to start and stop the VFD. In the AUTO position, the VFD will start/stop from a remote contact closure. In the HAND position, the VFD will run regardless of the remote contact position.
2. Manual speed control capability.
3. Local selector switch: Motor speed is determined by the manual speed control.
4. Power/On light to indicate that the VFD is receiving utility power.
5. Fault light to indicate that the VFD has tripped on a fault condition.
6. Digital meter with selector switch to indicate percent speed and percent load.
7. A set of form-C, dry contacts to indicate when the VFD is in the run mode.
8. A set of form-C, dry contacts to indicate when the VFD is in the fault mode.
9. A 0-10VDC or 4020 mA output signal to vary in direct proportion to the controller's speed.
10. VFD to have terminal strip to accept N.C. safety contacts. VFD to safety shut down in drive or by-pass mode when contacts open.
11. VFD to accept an additional N.C. contact to interface with the Hand/Off/Auto switch for remote Stop/Start control.
12. VFD shall accept an external 0-10 VDC or 4-20 mA speed control signal.
13. VFD shall have Proportional Integral Derivative (PID) loop control for VFD operation and independent PID loop control for Owner use.

**L. Adjustments**

1. Maximum speed, adjustable 50-100% base speed.
2. Minimum speed, adjustable 0-50% base speed.
3. Acceleration time, adjustable 3-60 seconds.
4. Deceleration times, adjustable 3-60 seconds with override circuit to prevent nuisance trips if deceleration time is set too short.
5. Current limit, adjustable 0-105%.
6. Overload trip set point.
7. Offset and gain to condition the input speed signal.

**M. Special Features**

1. The following special features shall be included in the VFD enclosure:

- a. VFD shall include a communication port with standard protocols (LON/BACnet/Modbus) to match Owner DDC system. Coordinate with DDC manufacturer to provide a seamless interface between the VFD and DDC system.
  - b. All panels shall be marked for 100,000 AMP short circuit current rating in compliance with UL.
  - c. Provide a manual door interlocked main fused disconnect switch, pad lockable in the off position.
2. All power and low voltage terminations into and out of VFD shall be through the bottom of drive cabinet through factory provided knock-outs.
  3. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 120% of rated torque for up to 0.5 seconds while starting. The VFD shall provide full motor torque at any selected frequency from 20 Hz to based speed while providing a variable torque V/Hz output at reduced speed. Breakaway torque of 160% shall be available.
  4. The VFD shall include current sensors on all output phases.
  5. The VFD shall continue to operate with reduced output without faulting with input voltage as low as 70% of the nominal voltage and shall provide full rated output for input voltages of 90% of nominal.
  6. The VFD shall have a minimum of Class 20 I2t motor overload protection, which shall automatically compensate for changes in motor speed.
  7. All VFDs shall have the same interchangeable customer interface keypad to allow a single programmable keypad to download information to multiple VFDs during startup procedures.
  8. The VFD shall accept up to 3 feedback signals, each with independent scaling.
  9. None of the above features shall affect the UL or ETL listing of the unit.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Provide factory mounting brackets and attachments for VFDs. Field modification or drilling of enclosures is not permitted. Mounting brackets and supports shall not block required access and clearances for VFD.

### 3.2 START-UP AND COMMISSIONING SERVICE

- A. The manufacturer shall provide start-up commissioning of the variable frequency drive and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the customer's site. Sales personnel and other agents who are not factory certified technicians for drive field repairs shall not be acceptable as commissioning agents. Coordinate commissioning requirements with the Commissioning Authority as specified under Section 230800 "Commissioning of HVAC."



- B. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system. Included in this service shall be (as a minimum):
1. Verification of contractor wire terminations to the VFD and its optional circuitry.
  2. Installation verification for proper operation and reliability of the VFD, the motor being drive, and the building automation system.
  3. Conform to training requirements specified elsewhere. In addition, the VFD manufacturer's certified trainer shall provide up to one-hour of customer operator training on operation and service diagnostics at the time of the equipment commissioning.
  4. Measurements for verification of proper operation on each of the following items:
    - a. Motor voltage and frequency. Verification of proper motor operation.
    - b. Control input for proper building automation system interface and control calibration.
    - c. Calibration check for the following setpoints (and adjustments as necessary):
      - 1) minimum speed
      - 2) maximum speed
      - 3) acceleration rate
      - 4) deceleration rate
    - d. VFD manufacturer technician shall document all default and custom drive settings.
  5. Submit Start-Up and Commissioning Reports.

### **3.3 EXAMINATION**

- A. Contractor shall coordinate with Manufacturer/Supplier to verify that jobsite meets factory recommended and code required conditions for proper VFD installation prior to the installation. Additionally, contractor shall address Manufacturer/Supplier's recommendations to assure proper installation prior to the installation. Manufacturer/Supplier shall visit jobsite subsequent to the installation to verify VFD's are installed properly. Items considered shall include (at a minimum):
1. Clearance spacing
  2. Temperature, contamination, dust, and moisture of the environment.
  3. Separate conduit installation of the motor wiring, power wiring, and control wiring.
  4. Installation per the manufacturer's recommendation.
  5. Measure voltage rise, time, and magnitude.
  6. Cover and protect the VFD from installation dust and contamination until the environment is cleaned and ready for operation. The VFD shall not be operated while the unit is covered.
  7. VFD input and output power shall be installed in separate conduits.

**END OF SECTION 23 05 49**

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## **SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Duct labels.
  - 5. Valve tags.
  - 6. Warning tags.

#### **1.3 ACTION SUBMITTALS**

- A. Submittals shall be formatted per Section 230000 "General Mechanical Requirements".
- B. Product Data: For each type of product.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

#### **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 GENERAL**

- A. Manufacturers:

1. Craftmark Identification Systems
2. Seton Identification Products
3. MSI Marking Services
4. Setmark

## **2.2 EQUIPMENT LABELS**

### **A. Plastic Labels for Equipment:**

1. Material and Thickness: Three-layer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick and having predrilled holes for attachment hardware.
2. Color Coding:
  - a. Letter Color: White.
  - b. Background Color: Red.
3. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless-steel rivets or contact-type permanent adhesive, compatible with label and 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.**

## **2.3 WARNING SIGNS AND LABELS**

### **A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.**

### **B. Color Coding:**

1. Background Color: Yellow.
2. Letter Color: Black.

### **C. Maximum Temperature: Able to withstand temperatures up to 160 deg F.**

- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- F. Fasteners: Stainless-steel rivets or self-tapping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Label Content: Include caution and warning information, plus emergency notification instructions.

## **2.4 PIPE LABELS**

- A. Do not use pipe labels or plastic tapes for bare pipes conveying fluids at temperatures of 125 deg F (52 deg C) or higher.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- C. Pre-tensioned Pipe Labels for Outside Diameter Less or Equal to 8 Inches: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels for Outside Diameter Greater than 8 Inches: Printed plastic with contact-type, permanent-adhesive backing. Either marker shall show accepted color-coded background, proper color of legend in relation to background color, accepted legend letter size, accepted marker length.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, 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.

## **2.5 DUCT LABELS**

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

- D. 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.
- E. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- F. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.

## **2.6 VALVE TAGS**

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2 inch sequenced numbers.
  - 1. Tag Material: Brass, 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.

## **2.7 WARNING TAGS**

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
  - 1. Size: Approximately 4 by 7 inches.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption such as "DANGER", "CAUTION" or "DO NOT OPERATE."
  - 4. Color:
    - a. Background Color: Yellow.
    - b. Letter Color: Black.

## **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 GENERAL INSTALLATION REQUIREMENTS**

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### **3.3 EQUIPMENT LABEL INSTALLATION**

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### **3.4 PIPE LABEL INSTALLATION**

- A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting"
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Within one foot of each valve and control device.
  - 2. Near each branch connection and riser takeoff.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. Near major equipment items and other points of origination and termination.
  - 5. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 6. Spaced at maximum intervals of 20 feet along each run, but not less than once in each room at entrance and exit of each concealed space.
  - 7. On piping above removable acoustical ceilings.
- C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- D. Pipe Label Color Schedule:
  - 1. Refrigerant Piping:

- a. Background Color: Yellow.
  - b. Letter Color: Black.
2. Chilled-Water Piping:
    - a. Background Color: Green.
    - b. Letter Color: White.
  3. Heating Water Piping:
    - a. Background Color: Yellow.
    - b. Letter Color: Black.

### **3.5 DUCT LABEL INSTALLATION**

- A. Locate ductwork labels where ductwork is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  1. Within one foot of each control device.
  2. Near each branch connection and riser takeoff.
  3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  4. Near major equipment items and other points of origination and termination.
  5. Spaced at maximum intervals of 20 feet along each run, but not less than once in each room at entrance and exit of each concealed space.
  6. On ductwork above removable acoustical ceilings.
- B. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
  1. Exhaust Air Ducts:
    - a. Background Color: Yellow.
    - b. Letter Color: Black.
  2. Supply Air and Outside Air:
    - a. Background Color: Blue.
    - b. Letter Color: White
  3. Return Air:
    - a. Background Color: Green.
    - b. Letter Color: White



### **3.6 VALVE-TAG INSTALLATION**

- A. Install tags on valves and control devices in piping systems, except valves within factory-fabricated equipment units; faucets; convenience and lawn-watering hose connections. 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. Chilled Water: 2 inches, round.
    - b. Hot Water: 2 inches, round.
    - c. Refrigerant: 2 inches, round.
  - 2. Valve-Tag Color:
    - a. Chilled Water: Natural.
    - b. Hot Water: Natural.
    - c. Refrigerant: Natural.
  - 3. Letter Color:
    - a. Chilled Water: Black.
    - b. Hot Water: Black.
    - c. Refrigerant: Black.
- C. All above and below grade and interior and exterior valves shall be tagged. Submit valve tag chart to the Owner Representative for review and approval at the completion of the project.

### **3.7 WARNING-TAG INSTALLATION**

- A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION 23 05 53**

**P2S Inc.**  
005.2882.000

January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

## SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Balancing Air Systems:
    - a. Constant-volume air systems.
    - b. Variable-air-volume systems.
  - 2. Balancing Hydronic Piping Systems:
    - a. Variable-flow hydronic systems.
  - 3. Testing, Adjusting, and Balancing Equipment:
    - a. Motors.
    - b. Heat-transfer coils.
  - 4. Sound tests.
  - 5. Duct leakage tests.
  - 6. Control system verification.

#### 1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. BAS: Building automation systems.
- C. NEBB: National Environmental Balancing Bureau.
- D. TAB: Testing, adjusting, and balancing.
- E. TABB: Testing, Adjusting, and Balancing Bureau.
- F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- G. TDH: Total dynamic head.

#### **1.4 PREINSTALLATION MEETINGS**

- A. TAB Conference: If requested by the Owner, conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.
  - 1. Minimum Agenda Items:
    - a. The Contract Documents examination report.
    - b. The TAB plan.
    - c. Needs for coordination and cooperation of trades and subcontractors.
    - d. Proposed procedures for documentation and communication flow.

#### **1.5 ACTION SUBMITTALS**

#### **1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: Submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. System Readiness Checklists: Submit system readiness checklists as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.

#### **1.7 QUALITY ASSURANCE**

- A. TAB Specialists Qualifications: Engage an independent TAB Contractor certified by AABC, NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC, NEBB or TABB.
  2. TAB Technician: Employee of the TAB specialist and certified by AABC, NEBB or TABB as a TAB technician.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

## **1.8 FIELD CONDITIONS**

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

## **PART 2 - PRODUCTS (Not Applicable)**

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they 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 verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine operating safety interlocks and controls on HVAC equipment.
- O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
1. Equipment and systems to be tested.
  2. Strategies and step-by-step procedures for balancing the systems.
  3. Instrumentation to be used.
  4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
1. Airside:

- a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
- b. Duct systems are complete with terminals installed.
- c. Volume, smoke, and fire dampers are open and functional.
- d. Clean filters are installed.
- e. Fans are operating, free of vibration, and rotating in correct direction.
- f. Variable-frequency controllers' startup is complete and safeties are verified.
- g. Automatic temperature-control systems are operational.
- h. Ceilings are installed.
- i. Windows and doors are installed.
- j. Suitable access to balancing devices and equipment is provided.

### **3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING**

- A. Perform testing and balancing procedures on each system according to the procedures contained in ASHRAE 111 or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
- 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. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
  3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," and Section 230719 "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. Cross-check 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 233113 "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. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
  - 2. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report artificial loading of filters at the time static pressures are measured.
  - 3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  - 4. Obtain approval from commissioning authority for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  - 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor



amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
  - 1. Measure airflow of submain and branch ducts.
  - 2. Adjust submain and branch duct volume dampers for specified airflow.
  - 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
  - 1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
  - 2. Measure inlets and outlets airflow.
  - 3. Adjust each inlet and outlet for specified airflow.
  - 4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
  - 1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
  - 2. Re-measure and confirm that total airflow is within design.
  - 3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
  - 4. Mark all final settings.
  - 5. Test system in economizer mode. Verify proper operation and adjust if necessary.
  - 6. Measure and record all operating data.
  - 7. Record final fan-performance data.

### **3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS**

- A. Adjust the variable-air-volume systems as follows:
  - 1. Verify that the system static pressure sensor is installed.
  - 2. Verify that the system is under static pressure control.
  - 3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
  - 4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
    - a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
    - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
    - c. When maximum airflow is correct, balance the air outlets downstream from terminal units.

- d. Adjust controls so that terminal is calling for minimum airflow.
  - e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
  - f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
  - g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
- a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
  - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
  - c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
  - d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
  - e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
6. Measure fan static pressures as follows:
- a. Measure static pressure directly at the fan outlet or through the flexible connection.
  - b. Measure static pressure directly at the fan inlet or through the flexible connection.
  - c. Measure static pressure across each component that makes up the air-handling system.
  - d. Report any artificial loading of filters at the time static pressures are measured.
7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
- a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
  - b. Verify that terminal units are meeting design airflow under system maximum flow.
8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
9. Verify final system conditions as follows:
- a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
  - b. Re-measure and confirm that total airflow is within design.
  - c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
  - d. Mark final settings.

- e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
- f. Verify tracking between supply and return fans.

### 3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
  - 1. Check liquid level in expansion tank.
  - 2. Check highest vent for adequate pressure.
  - 3. Check flow-control valves for proper position.
  - 4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
  - 5. Verify that motor starters are equipped with properly sized thermal protection.
  - 6. Check that air has been purged from the system.

### 3.8 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 in General Procedures for Hydronic Systems.
- B. For systems with diversity:
  - 1. Determine diversity factor.
  - 2. Simulate system diversity by closing required number of control valves, as approved by the design engineer.
  - 3. Adjust flow-measuring devices installed in mains and branches to design water flows.
    - a. Measure flow in main and branch pipes.
    - b. Adjust main and branch balance valves for design flow.
    - c. Re-measure each main and branch after all have been adjusted.
  - 4. Adjust flow-measuring devices installed at terminals for each space to design water flows.
    - a. Measure flow at terminals.
    - b. Adjust each terminal to design flow.
    - c. Re-measure each terminal after it is adjusted.
    - d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
    - e. Perform temperature tests after flows have been balanced.

5. For systems with pressure-independent valves at terminals:
  - a. Measure differential pressure, and verify that it is within manufacturer's specified range.
  - b. Perform temperature tests after flows have been verified.
6. For systems without pressure-independent valves or flow-measuring devices at terminals:
  - a. Measure and balance coils by either coil pressure drop or temperature method.
  - b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
7. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.
8. Prior to verifying final system conditions, determine system differential-pressure set point.
9. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
10. Mark final settings and verify that memory stops have been set.
11. Verify final system conditions as follows:
  - a. Re-measure and confirm that total water flow is within design.
  - b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
  - c. Mark final settings.
12. Verify that memory stops have been set.

### **3.9 PROCEDURES FOR MOTORS**

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  1. Manufacturer's name, model number, and serial number.
  2. Motor horsepower rating.
  3. Motor rpm.
  4. Phase and hertz.
  5. Nameplate and measured voltage, each phase.
  6. Nameplate and measured amperage, each phase.
  7. Starter size and thermal-protection-element rating.
  8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

### **3.10 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 for major equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
  4. Dry-bulb temperature of entering and leaving air.
  5. Wet-bulb temperature of entering and leaving air for cooling coils.
  6. Airflow.
- 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.
  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. 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.

### **3.11 SOUND TESTS**

- A. After the systems are balanced and construction is Substantially Complete, measure and record sound levels at 10 locations as designated by the Architect.
- B. Instrumentation:
1. The sound-testing meter shall be a portable, Type-1 or Type-2 sound level meter consisting of a microphone, processing unit, and readout.
  2. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels, and measuring the equivalent continuous sound pressure level (LEQ).
  3. The sound-testing meter must be capable of using octave band filters to measure mid-frequencies from 31.5 Hz to 8000 Hz.
- C. Test Procedures:
1. Perform test at quietest background noise period. Note cause of unpreventable sound that affects test outcome.
  2. Equipment should be operating at design values.
  3. Calibrate the sound-testing meter prior to taking measurements.

4. Use a microphone suitable for the type of noise levels measured that is compatible with meter. Provide a windshield for indoor and outdoor measurements.
5. Record a set of background measurements in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment off.
6. Take sound readings at a minimum of 4 locations in each room in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment operating.
7. Take readings no closer than 60 inches from a wall or from the operating equipment and approximately 60 inches from the floor, with the meter held or mounted on a tripod.

D. Reporting:

1. Report shall record the following:
  - a. Location.
  - b. System tested.
  - c. dBA reading.
  - d. Sound pressure level in each octave band with equipment on and off.
2. Plot sound pressure levels on NC worksheet with equipment on and off.

### **3.12 DUCT LEAKAGE TESTS**

- A. Witness the duct pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified tolerances.
- C. Report deficiencies observed.

### **3.13 CONTROLS VERIFICATION**

- A. In conjunction with system balancing, perform the following:
  1. Verify temperature control system is operating within the design limitations.
  2. Confirm that the sequences of operation are in compliance with Contract Documents.
  3. Verify that controllers are calibrated and function as intended.
  4. Verify that controller set points are as indicated.
  5. Verify the operation of lockout or interlock systems.
  6. Verify the operation of valve and damper actuators.
  7. Verify that controlled devices are properly installed and connected to correct controller.
  8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
  9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.
- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

### **3.14 TOLERANCES**

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 5 percent.
  - 2. Air Outlets and Inlets: Plus or minus 10 percent.
  - 3. Heating-Water Flow Rate: Plus or minus 5 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

### **3.15 PROGRESS REPORTING**

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for 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 weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### **3.16 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.
  - 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  - 1. Pump curves.
  - 2. Fan curves.
  - 3. Manufacturers' test data.
  - 4. Field test reports prepared by system and equipment installers.
  - 5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
  - 1. Title page.
  - 2. Name and address of the TAB specialist.
  - 3. Project name.

4. Project location.
  5. Architect's name and address.
  6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for terminal units, including manufacturer's name, type, size, and fittings.
  14. Notes to explain why certain final data in the body of reports vary from indicated values.
  15. Test conditions for fans 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.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.



- h. Sheave make, size in inches, and bore.
  - i. Center-to-center dimensions of sheave and amount of adjustments in inches.
  - j. Number, make, and size of belts.
  - k. Number, type, and size of filters.
2. Motor Data:
- a. Motor make, and frame type and size.
  - b. Horsepower and rpm.
  - c. Volts, phase, and hertz.
  - d. Full-load amperage and service factor.
  - e. Sheave make, size in inches, and bore.
  - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
3. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm.
  - b. Total system static pressure in inches wg.
  - c. Fan rpm.
  - d. Discharge static pressure in inches wg.
  - e. Filter static-pressure differential in inches wg.
  - f. Dx coil static-pressure differential in inches wg.
  - g. Outdoor airflow in cfm.
  - h. Return airflow in cfm.
  - i. Outdoor-air damper position.
  - j. Return-air damper position.
4. Test Data (Indicated and Actual Values):
- a. Airflow rate in cfm.
  - b. Average face velocity in fpm.
  - c. Air pressure drop in inches wg.
  - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
  - e. Return-air, wet- and dry-bulb temperatures in deg F.
  - f. Entering-air, wet- and dry-bulb temperatures in deg F.
  - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
  - h. Refrigerant expansion valve and refrigerant types.
  - i. Refrigerant suction pressure in psig.
  - j. Refrigerant suction temperature in deg F.
  - k. Inlet steam pressure in psig.
- F. Apparatus-Coil Test Reports:
1. Coil Data:
- a. System identification.
  - b. Location.
  - c. Coil type.
  - d. Number of rows.
  - e. Fin spacing in fins per inch o.c.

- f. Make and model number.
  - g. Face area in sq. ft.
  - h. Tube size in NPS.
  - i. Tube and fin materials.
  - j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
- a. Airflow rate in cfm.
  - b. Average face velocity in fpm.
  - c. Air pressure drop in inches wg.
  - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
  - e. Return-air, wet- and dry-bulb temperatures in deg F.
  - f. Entering-air, wet- and dry-bulb temperatures in deg F.
  - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
  - h. Water flow rate in gpm.
  - i. Water pressure differential in feet of head or psig.
  - j. Entering-water temperature in deg F.
  - k. Leaving-water temperature in deg F.
  - l. Refrigerant expansion valve and refrigerant types.
  - m. Refrigerant suction pressure in psig.
  - n. Refrigerant suction temperature in deg F.
  - o. Inlet steam pressure in psig.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
  - a. System identification.
  - b. Location.
  - c. Make and type.
  - d. Model number and size.
  - e. Manufacturer's serial number.
  - f. Arrangement and class.
  - g. Sheave make, size in inches, and bore.
  - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
2. Motor Data:
  - a. Motor make, and frame type and size.
  - b. Horsepower and rpm.
  - c. Volts, phase, and hertz.
  - d. Full-load amperage and service factor.
  - e. Sheave make, size in inches, and bore.
  - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
  - g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
  - a. Total airflow rate in cfm.

- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Suction static pressure in inches wg.

H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

- a. System and air-handling-unit number.
- b. Location and zone.
- c. Traverse air temperature in deg F.
- d. Duct static pressure in inches wg.
- e. Duct size in inches.
- f. Duct area in sq. ft..
- g. Indicated airflow rate in cfm.
- h. Indicated velocity in fpm.
- i. Actual airflow rate in cfm.
- j. Actual average velocity in fpm.
- k. Barometric pressure in psig.

I. Air-Terminal-Device Reports:

1. Unit Data:

- a. System and air-handling unit identification.
- b. Location and zone.
- c. Apparatus used for test.
- d. Area served.
- e. Make.
- f. Number from system diagram.
- g. Type and model number.
- h. Size.
- i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Air velocity in fpm.
- c. Preliminary airflow rate as needed in cfm.
- d. Preliminary velocity as needed in fpm.
- e. Final airflow rate in cfm.
- f. Final velocity in fpm.
- g. Space temperature in deg F.

J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

- a. System and air-handling-unit identification.
  - b. Location and zone.
  - c. Room or riser served.
  - d. Coil make and size.
  - e. Flowmeter type.
2. Test Data (Indicated and Actual Values):
- a. Airflow rate in cfm.
  - b. Entering-water temperature in deg F.
  - c. Leaving-water temperature in deg F.
  - d. Water pressure drop in feet of head or psig.
  - e. Entering-air temperature in deg F.
  - f. Leaving-air temperature in deg F.

K. Instrument Calibration Reports:

1. Report Data:
  - a. Instrument type and make.
  - b. Serial number.
  - c. Application.
  - d. Dates of use.
  - e. Dates of calibration.

### 3.17 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of the construction manager.
- B. The construction manager authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, proceed as follows:
  1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.

2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
  3. If the second verification also fails, Owner may contact AABC Headquarters regarding the AABC National Performance Guaranty.
- F. Prepare test and inspection reports.

### **3.18 ADDITIONAL TESTS**

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

**END OF SECTION 23 05 93**

**P2S Inc.**  
005.2882.000

January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

## SECTION 23 07 13 - DUCT INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section. Review these documents for coordination with additional requirements and information that apply to work under this Section

#### 1.2 SUMMARY

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, concealed return air.
  - 3. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
- B. Related Sections:
  - 1. Section 230719 "HVAC Piping Insulation."
  - 2. Section 233113 "Metal Ducts" for duct liners.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall be formatted per Section 230000 "General Mechanical Requirements".
- B. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  - 3. Detail application of field-applied jackets.
  - 4. Detail application at linkages of control devices.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

## **1.5 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.

## **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 230529 "Hangers and Supports for HVAC."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

## **1.8 SCHEDULING**

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.



## **PART 2 - PRODUCTS**

### **2.1 INSULATION MATERIALS**

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation; SoftTouch Duct Wrap
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Friendly Feel Duct Wrap.
    - d. Owens Corning; SOFTR All-service Duct Wrap.

### **2.2 FIRE-RATED INSULATION SYSTEMS**

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M.
    - b. Morgan Thermal Ceramics

### **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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller
    - c. Knauf Insulation.
  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. Vapor-Barrier Permeance: ASTM 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
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. Childers Brand; H. B. Fuller Construction Products.; CP10
    - b. Eagle Bridges - Marathon Industries.; 550
    - c. Foster Brand; H. B. Fuller Construction Products.; 146-50
  2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
  3. Service Temperature Range: Minus 50 to plus 220 deg F.
  4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
  5. Color: White.

## **2.4 SEALANTS**

- A. FSK and Metal Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.; CP-76.
    - b. Foster Brand; H. B. Fuller Construction Products.; 95-44.
    - c. Mon-Eco Industries, Inc.; 44-05
    - d. Eagle Bridges – Marathon Industries; 405.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: 20 to plus 250 deg F.
  5. Color: Aluminum.

6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that 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," including 2004 Addenda.

## **2.5 TAPES**

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Compac Corporation; 110 and 111.
    - b. ABI, Ideal Tape Division; 491 AWF FSK.
    - c. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
    - d. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
  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.

## **2.6 SECUREMENTS**

- A. Bands:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ITW Insulation Systems; Illinois Tool Works, Inc.; 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 wing seal or closed seal.
  3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
  4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Midwest Fasteners or approved equal.
    - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

- c. Spindle: Zinc-coated, low-carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive-backed base with a peel-off protective cover.
5. 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.
- B. Wire: 0.062-inch soft-annealed, stainless steel.
- 1. Manufacturers: Subject to compliance with requirements, provide product by:
    - a. C & F Wire, or equal.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

#### **3.3 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.

- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### **3.4 PENETRATIONS**

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
  
- B. Insulation Installation at 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 078413 "Penetration Firestopping."
  
- E. Insulation Installation at Floor Penetrations:
  - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### **3.5 INSTALLATION OF MINERAL-FIBER INSULATION**

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 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 over compress 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 un-faced 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.

### 3.6 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.

- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

### **3.7 DUCT INSULATION SCHEDULE, GENERAL**

#### **A. Plenums and Ducts Requiring Insulation:**

- 1. Indoor, concealed supply and outdoor air (unless shown with liner on drawings or indicated to require liner in specification 233113 Metal Ducts).
- 2. Indoor, concealed return air (unless shown with liner on drawings or indicated to require liner in specification 233113 Metal Ducts).
- 3. Indoor, concealed, Type I, commercial, kitchen hood exhaust.

#### **B. Items Not Insulated:**

- 1. Metal ducts with duct liner of sufficient thickness to comply with Title 24 energy code.
  - a. See specification 233113 "Metal Ducts" section 3.12.F for duct liner schedule.
- 2. General exhaust air ducts.
- 3. Relief air ducts.
- 4. Factory-insulated flexible ducts.
- 5. Factory-insulated plenums and casings.
- 6. Flexible connectors.
- 7. Vibration-control devices.
- 8. Factory-insulated access panels and doors.

### **3.8 INDOOR DUCT AND PLENUM INSULATION SCHEDULE**

#### **A. Concealed supply air, return air and outside air duct and plenum insulation shall be the following:**

- 1. Mineral-Fiber Blanket: 1.5 inches thick and 0.75-lb/cu. ft. nominal density.

#### **B. Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket thickness as required to achieve 2-hour fire rating.**

**END OF SECTION 23 07 13**



## SECTION 23 07 19 - 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.
  - 2. Chilled-water piping.
  - 3. Heating hot-water piping.
  - 4. Refrigerant suction and hot-gas piping.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall be formatted per Section 230000 “General Mechanical Requirements”.
- B. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance, thickness, and jackets (both factory and field applied, if any). Clearly mark the materials being provided and its intended use of each product
- C. 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. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation

materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

- C. Field quality-control reports if requested by the Owner's Representative.

## **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.
- B. Insulation shall be delivered to the job site in original, unopened manufacturer's containers.
- C. Insulation shall be stored in a dry location and kept dry throughout construction.

## **1.7 COORDINATION**

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Systems."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

## **1.8 SCHEDULING**

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Products shall not contain CFC, asbestos, lead, mercury, or mercury compounds.
- B. Insulation shall meet fire and smoke hazard ratings as tested under procedure ASTM E-84, NFPA 255, and UL 723 and shall not exceed flame spread rating of 25 and maximum smoke developed rating of 50.
- C. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville's Micro-Lok *HP* all-service (ASJ) vapor-retarder jacket with a self-sealing longitudinal closure lap (SSL) and butt strips.
    - b. Owens Corning; ASJ Fiberglas Pipe Insulation.
  - 2. Preformed mineral fiber pipe insulation with factory applied all-service vapor-retarder jacket (ASJ) jacket with a self-sealing longitudinal closure lap (SSL) and butt strips or approved alternate to seal butt joints. Preformed mineral fiber pipe insulation shall conform to ASTM C547. The ASJ facing shall conform to ASTM C1136 Type I.
  - 3. Preformed mineral fiber pipe insulation with factory applied all-service vapor-retarder jacket (ASJ) jacket shall have a flame spread rating not greater than 25 and a smoke developed rating not greater than 50 when tested as in accordance with ASTM E84, UL 723.
  - 4. Thermal conductivity (k-value): 0.23 Btu-in/hr-ft<sup>2</sup>-°F at 75°F
  - 5. Preformed mineral fiber pipe insulation shall have a water vapor sorption of less than 5% by weight as tested in accordance ASTM C 547.
  - 6. All service jacket (ASJ) shall have a water vapor permeance of 0.02 perms or less as tested in accordance to ASTM E96, procedure "A".
  - 7. When a vapor mastic is required, a water vapor permeance of 0.02 per ASTM E-96 Procedure B must be achieved.
  - 8. All accessory materials such as field installed jackets, mastics, coatings, tapes, fasteners shall be recommended by each component manufacturer for the specified application or as listed in the NAIMA Guide to Insulating Chilled Water Systems with Mineral Fiber Pipe Insulation.
  - 9. Fittings, valves, tees, etc. shall be insulated with fiberglass insulation inserts covered with white PVC insulated fitting covers.
- D. Phenolic Pipe Insulation:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dyplast Products. Dytherm Phenolic
    - b. Resolco Inc. Insul-Phen Green.
    - c. Polyguard.

2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
4. Thermal conductivity (k-value): 0.18 Btu-in/hr-ft<sup>2</sup>-°F at 75°F
5. Factory fabricate shapes according to ASTM C 450 and ASTM C 585

E. Flexible Elastomeric Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Armacell LLC Armaflex.
  - b. Aeroflex USA, Inc. Aerocel.
  - c. K-Flex USA Insul-sheet.
2. Closed-cell. Comply with ASTM C 534, Type I for tubular materials.
3. Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
4. Pipe insulation shall be fabricated according to the requirements of ASTM C1639 "Standard Specification for Fabrication of Cellular Glass Pipe and Tubing Insulation".
5. Thermal Conductivity: 0.25 Btu-in/hr-ft<sup>2</sup>-°F at 75°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. Adhesives shall contain no flammable solvents if that option is available.
- B. Flexible Elastomeric 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 LCC; 520 BLV Adhesive.
    - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
    - d. RBX Corporation; Rubatex Contact Adhesive.
  2. For indoor applications use adhesive that has 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, provide one of the following:
    - a. Design Polymerics DP 2590-CA
    - b. ITW TACC, Division of Illinois Tool Works; SP80, T1080
    - c. Marathon Industries, Inc.

2. For indoor applications use adhesive that has 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, provide one of the following:
    - a. Design Polymerics DD2590-CA.
    - b. ITW TACC, Division of Illinois Tool Works; SP80, T1080
    - c. Marathon Industries, Inc.
  2. For indoor applications use adhesive that has 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 water based and 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 40 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 and outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-35.
    - b. Design Polymerics 3040 with zero VOC's.
    - c. Foster Products Corporation, H. B. Fuller Company; 30-90.
  2. Water-Vapor Permeance: ASTM E 96, 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 Products, Division of ITW; CP-10.
    - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
    - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
  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 Products, Division of ITW; CP-76.
  - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
  - c. Marathon Industries, Inc.; 405.
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.
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. FSK and Metal Jacket Flashing Sealants:**

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Products, Division of ITW; CP-76-8.
  - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
  - c. Marathon Industries, Inc.; 405.
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 use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### **C. ASJ Flashing Sealants:**

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Products, Division of ITW; CP-76.
  - b. Or equal.
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 and use sealants that 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. 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 D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. 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. PVC Jacket Color:
    - a. Chilled-Water Piping:
      - 1) Chilled Water Supply: Dark Blue
      - 2) Chilled Water Return: Light Blue
    - b. Heating Hot Water Piping:
      - 1) Heating Hot Water Supply: Dark Red
      - 2) Heating Hot Water Return: Light Red
  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. Moisture Barrier Jacket:
1. Manufacturer: Pittsburg Corning PITTWRAP or approved equal.
  2. 125 mil thick heat-seal multi-ply laminate consisting of three layers of a polymer-modified bituminous compound separated by glass reinforcement and aluminum foil.

- 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 Products, Division of ITW; Metal Jacketing Systems.
    - b. PABCO Metals Corporation; Surefit.
    - c. RPR Products, Inc.; Insul-Mate.
  2. Factory cut and rolled to size.
  3. Finish and thickness are indicated in field-applied jacket schedules.
  4. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
  5. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and 40 pound kraft paper.
  6. Factory-Fabricated Fitting Covers:
    - a. Same material, finish, and thickness as jacket.
    - b. Preformed 2-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.

## **2.7 REMOVABLE INSULATION JACKETS**

- A. Manufacturers:
1. ThermaXX LLC.
  2. INSULTECH.
  3. Firwin.
- B. Insulation:
1. Glass mat, type E needled fiber, 1" at 11.3 LB/CF.
  2. Maximum Use Temperature 400 deg F.
- C. Jacket:
1. Hot Side
    - a. PTFE Fiberglass Composite Jacketing, 16.5 oz/sq. yd. minimum
    - b. Estimation of Maximum Use Temperature 550 deg F.
  2. Cold Side
    - a. PTFE Fiberglass Composite Jacketing, 16.5 oz/sq. yd. minimum



b. Estimation of Maximum Use Temperature 600 deg F.

D. Thread:

1. Does not decompose below 800 deg F.
2. Does not melt.
3. Diameter: 0.0114
4. Break Point: 35 Lbs.

E. Construction:

1. Double sewn lock stitch with a minimum 4 to 6 stitches per inch. Jackets shall be sewn with two (2) parallel rows of stitching. The thread must be able to withstand the skin temperatures without degradation.
2. Hog rings, staples, and wire are not acceptable methods of closure.
3. No raw cut jacket edges shall be exposed.
4. Jackets shall be fastened using hook and loop (Velcro) straps and 1" slide buckles.
5. Provide a permanently attached aluminum or stainless-steel nameplate on each jacket to identify its location, size, and tag number.
6. Provide a stainless steel or brass grommet at the low point of each jacket, in wet areas for moisture drain (on horizontal jackets as required).
7. The insulation shall be designed to minimize the convection current in the space between the hot metal surface and the inner layer of insulation. To this end, during jacket fabrication, the layers of insulating mat shall be placed in an overlapping pattern.
8. All jacket pieces which match mating seams must include an extended 2" flap constructed from the exterior fabric and shall be secured using hook & loop closure (Velcro) parallel to the seam.
9. Insulation must be sewn as integral part of the jacket to prevent shifting of the insulation.

## **2.8 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. 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. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
    - b. Compac Corp.; 130.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    - d. 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. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - b. Compac Corp.; 120.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
  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.

## 2.9 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch thick, 1/2 inch 3/4 inch wide with 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. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, Monel.
  - 1. Manufacturers: Subject to compliance with requirements, provide product by:
    - a. C & F Wire.
    - b. Childers Products.
    - c. PABCO Metals Corporation.
    - d. RPR Products, Inc.

## 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 all inspection and acceptance testing of the piping as required by the specification has been completed and that the piping is ready for installation of insulation.
  - 2. Verify that surfaces to be insulated are clean and dry.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 4. Verify there is adequate clearance to install the pipe insulation in accordance with the operation performance parameters of the specification, such as access to controls, valves and for maintenance and repair.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Insulation shall not be installed until the following have been completed and documentation has been submitted to Owner for approval and record:

1. Cleaning and flushing
  2. Pressure testing
- B. 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.
- C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- D. 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.
- E. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- F. Install multiple layers of insulation with longitudinal and end seams staggered.
- G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- H. Keep insulation materials dry during application and finishing.
- I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- J. Install insulation with least number of joints practical.
- K. Install rigid pre-insulated pipe supports to protect from compression of insulation material due to point loads.
- L. Provide aluminum sleeves at all pipe support joints, between hanger support and exterior layer of insulating systems, to protect from compression of insulation material due to point loads.
- M. Install insulation on piping accessories requiring future reoccurring access and service with factory fabricated insulation covers that are easily removed and reapplied.
- N. For below-ambient services, 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 for below-ambient services, 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.
- O. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

- P. 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 1.5 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. For below-ambient services, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- Q. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- R. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- S. 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.
- T. Existing pipe insulation damaged or affected by the work of this contract shall be repaired to comply with these specifications except that materials and thicknesses may match existing unless otherwise directed by the Owner's Representative.
- U. 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:**

1. Terminate insulation with sleeve seal at wall penetration.
2. 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:** Install insulation continuously through walls and partitions.

**E. 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 078413 "Penetration Firestopping."

### **3.5 GENERAL PIPE INSULATION INSTALLATION**

**A. 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, 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. Label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- B. 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.
- C. 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 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. For below-ambient services, 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.
5. On chilled water systems, the butt end of every fourth pipe insulation section, and the ends or raw edges of insulation terminations at equipment connections, fittings and fire stop systems shall be sealed with vapor retarder mastic per NAIMA Guide to Insulation Chilled Water Systems, 2015.

#### **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.

### **3.7 INSTALLATION OF PHENOLIC INSULATION**

#### **A. General Installation Requirements:**



1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

**B. Insulation Installation on Straight Pipes and Tubes:**

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. For below-ambient services, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

**C. Insulation Installation on Pipe Flanges:**

1. Install 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.

**D. Insulation Installation on Pipe Fittings and Elbows:**

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

**E. Insulation Installation on Valves and Pipe Specialties:**

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

### **3.8 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.

### **3.9 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 1.5-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 as follows:

1. With 1-inch overlap at longitudinal seams and end joints; for horizontal applications.
2. Seal with manufacturer's recommended adhesive.
3. 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 as follows:

1. With 2-inch overlap at longitudinal seams and end joints.
2. Overlap longitudinal seams arranged to shed water.

3. Seal end joints with weatherproof sealant recommended by insulation manufacturer.
4. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### **3.10 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### **3.11 PIPING INSULATION SCHEDULE, GENERAL**

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range.

### **3.12 ABOVEGROUND PIPING INSULATION SCHEDULE**

- A. Chilled Water Supply and Return, Outdoors, 40°F and above:
  1. NPS 1.25 inch and smaller: Phenolic, pre-formed pipe insulation, 0.5 inch thick.
  2. NPS 1.5 inch and larger: Phenolic, pre-formed pipe insulation, 1 inch thick.
- B. Chilled Water Supply and Return, Indoors, 40°F and above:
  1. NPS 1.25 inch and smaller: Mineral Fiber, pre-formed pipe insulation, 0.5 inch thick.
  2. NPS 1.5 inch and larger: Mineral Fiber, pre-formed pipe insulation, 1 inch thick.
- C. Heating Hot Water Supply and Return, 200°F and below:
  1. NPS 1.25 inch and smaller: Mineral Fiber, pre-formed pipe insulation, 1.5 inches thick.
  2. NPS 1.5 inch and larger: Mineral Fiber, pre-formed pipe insulation, 2 inches thick.
- D. Refrigerant Piping:
  1. 2-Pipe Heat Pump System:
    - a. Low Pressure Gas Line, NPS smaller than 1 inch: Flexible elastomeric, 1 inch thick.
    - b. Low Pressure Gas Line, NPS 1 inch and larger: Flexible elastomeric, 1.5 inch thick.
    - c. Liquid Line: Flexible elastomeric, 1 inch thick.
- E. Condensate Drain Piping:
  1. All Pipe Sizes: Flexible elastomeric, 0.5 inch thick.

**3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Piping, Concealed: None.
- C. Piping, Exposed: PVC, Color-Coded by system, 30 mils thick for all indoor applications.

**3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Piping, Concealed: None.
- C. Piping, Exposed: Aluminum, Stucco Embossed, 0.024 inch thick.

**END OF SECTION 23 07 19**

## SECTION 23 08 00 - COMMISSIONING OF MECHANICAL

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

##### A. Commissioning

1. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the owner's project requirements and operational needs. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing adjusting and balancing, performance testing and training. Commissioning during the construction phase is intended to achieve the following specific objectives:
  - a. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
  - b. Verify and document proper functional performance of equipment and systems.
  - c. Verify that O&M documentation left on site is complete.
  - d. Verify that the Owner's operating personnel are adequately trained.

##### B. Facility Grid

1. The CxA utilizes, Facility Grid, cloud-based and mobile commissioning software platform to execute commissioning activities and deliverables. <https://facilitygrid.com/> CxA will provide project team members introduction to Facility Grid's platform.
2. Facility Grid will allow CxA, facility managers, architects, contractors, maintenance personnel, and corporate administrators can actually see and operate in the same loop real time. This transparency opens the door to major short and long-term efficiencies in all phases of the facilities management process.
3. Facility Grid defines the future of commissioning software by increasing the efficiency of commissioning agents, by streamlining commissioning projects and record keeping, by enabling project managers to see the big and small pictures in real time, across all projects, and by providing owners with a database of building information to benefit from today and in the future.
  - a. Real-Time Collaboration
  - b. Transparency
  - c. Team Engagement
  - d. Accountability
  - e. Information Sustainability

#### 1.2 RELATED WORK

##### A. Division 01 – General Requirements

1.     Section 013300 – Submittal Procedures
2.     Section 017700 – Closeout Procedures
3.     Section 019113 – General Commissioning Requirements

### **1.3     ABBREVIATIONS AND DEFINITIONS**

- A.     A/E: Design Professional
- B.     ASI: Architectural Supplemental Instruction
- C.     BAS: Building Automation System
- D.     BoD: Basis of Design. A narrative of how the designer plans to achieve the OPR.
- E.     CxA: Commissioning Authority
- F.     CC: Controls Contractor
- G.     CM: Construction Manager
- H.     Cx: Commissioning
- I.     Cx Plan: Commissioning Plan
- J.     Cx RFI: Commissioning Request for Information
- K.     DDC: Direct Digital Control System
- L.     Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents and cannot be corrected in five (5) minutes time.
- M.     EC: Electrical Contractor
- N.     FBO: Furnished By Others
- O.     FT: Functional Performance Test
- P.     GC: General Contractor
- Q.     IAW: In Accordance With
- R.     MC: Mechanical Contractor
- S.     O&M: Operation and Maintenance
- T.     OPM: Owner Project Manager
- U.     OPR: Owner Project Requirement. A dynamic document expressing how the owner expects the building systems to perform upon project completion.

- V. PC: Prefunctional Checklist
- W. RFI: Request for Information
- X. Sub(s): Subcontractors or Prime Contractor
- Y. TAB: Test, Adjust and Balance
- Z. TBD: To Be Determined

#### **1.4 MECHANICAL EQUIPMENT AND SYSTEMS TO BE COMMISSIONED**

The specific systems that shall be commissioned include:

- A. Mechanical Systems (and all integral equipment controls)
  - 1. Heating Hot Water BTU Meter
  - 2. Chilled Water BTU Meter
  - 3. Variable Air Handling Units
  - 4. Variable Air Volume Terminal Units w/ Heating Hot Water Coils
  - 5. Fan Coil Units
  - 6. General Building Exhaust Fans
  - 7. Dust Collector
  - 8. Building Automation System

#### **1.5 SUBMITTALS**

- A. Refer also to Specification Section 019113, Subsection 1.6.
- B. Provide the CxA a copy of the following items, for the systems to be commissioned:
  - 1. Equipment and System Submittals to include, at minimum, the following:
    - a. Equipment Data Sheets
    - b. Performance data
    - c. Manufacturer's pre-startup checklists
    - d. Manufacturer's start-up checklists
    - e. Installation Instructions
  - 2. Test, Adjust, and Balance (TAB) Reports
    - a. Planning Report - TAB contractor shall submit one copy of planning report (execution plan) to the CxA for review prior to beginning TAB work.
    - b. Initial Test Report – Prior to starting final Balance Phase, submit a copy of the initial test report (TAB punchlist) to the CxA to indicate problem areas to be resolved before final balance is completed.
    - c. Final Report – Submit one copy of final test report to the CxA within 7 days after fieldwork is complete.

3. Shop drawings (including any resubmittals required by the A/E)
4. Ductwork - Supply one copy of the duct leakage test results for each test section
5. Piping - Supply one copy of all of hydrostatic pressure test results
6. Initial Pre-startup and start-up plan
7. Startup Testing Report
  - a. Prepare startup testing report on a per system basis, documenting the results of executed testing plan.
  - b. Copies of all completed test forms and checklists shall be provided
  - c. List of all outstanding deficiencies and uncompleted items
8. Operational and maintenance documentation
9. Training plan and training materials
10. As-built documentation

## **PART 2 - PRODUCTS**

### **2.1 TEST EQUIPMENT**

- A. Refer to Specification Section 019113, Subsection 2.1.

## **PART 3 - EXECUTION**

### **3.1 MEETINGS**

- A. Refer to Specification Section 019113, Subsection 3.3.

### **3.2 START-UP, PREFUNCTIONAL CHECKLISTS, AND INITIAL CHECKOUT**

- A. The following procedures apply to all equipment to be commissioned, according to Subsection 1.4 above.
- B. General
  1. Prefunctional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
- C. Start-up and Initial Checkout Plan
  1. The CxA will provide prefunctional checklists (PFCs). PFCs indicate the required procedures to be executed as part of startup and initial checkout of the systems.
  2. The subcontractor responsible for providing and installing the equipment develops the full start-up plan by combining (or adding to) the CxA's prefunctional checklists with the



manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.

3. The full start-up plan shall consist of:
  - a. The CxA's prefunctional checklists.
  - b. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end
  - c. The manufacturer's normally used field checkout sheets
  - d. Specifically, the mechanical start-up plan shall also include the contractors TAB plan.
4. The contractor submits the full startup plan to the CxA for review and approval.
5. The CxA reviews and approves the procedures and the format for documenting them, noting any plans that need to be added.

D. Execution of Prefunctional Checklists and Startup

1. Two weeks prior to startup, the Subs and vendors schedule startup and checkout with the CM, GC and CxA. The performance of the prefunctional checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off prefunctional checklists, signatures may be required of other Subs for verification of completion of their work.
2. The CxA and possibly the A/E will observe the procedures for selected pieces of primary equipment.
3. The CxA will observe the physical start-up of all major systems.
4. The CxA will witness piping cleanout procedures and verify any required water or lab tests.
5. For lower-level components of equipment, (e.g., VAV boxes, sensors, controllers), the CxA will observe a sampling of the prefunctional and start-up procedures.
6. The Subs and vendors shall execute startup and provide the GC with a signed and dated copy of the completed start-up and prefunctional tests and checklists. The GC reviews for completion and accuracy, then submits to the CxA.
7. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.
8. Completed startup test report must be provided to CxA prior to functional testing.

E. Deficiencies, Non-Conformance and Approval in Checklists and Startup

1. The Subs shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully. The procedures form and any outstanding deficiencies shall be provided to the CxA within two days of test completion.
2. The CxA will work with the Subs and vendors to determine what is required to correct outstanding deficiencies and retest deficiencies of uncompleted items. The CxA will involve the CM, GC and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CxA as soon as outstanding items have been corrected.
3. Items left incomplete, which later cause deficiencies or delays during functional testing

may result in back charges to the responsible party. Refer to Specification Section 019113, Subsection 3.6 – DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS.

### **3.3 FUNCTIONAL PERFORMANCE TESTING**

- A. This subsection applies to functional testing and demonstration for equipment and system in this division.
- B. The general list of equipment and systems to be commissioned is found in Subsection 1.4.
- C. Objectives and Scope
  - 1. The objective of functional performance testing is to demonstrate that each system is operating according to the owner's project requirements, documented project program, and Contract Documents. Functional testing facilitates bringing the systems from a state of material completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and function of the systems.
  - 2. In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, failures, interlocks, warm-up, safety, etc.) where there is a specified system response. Verifying each sequence in the sequences of operation is required.
  - 3. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.
  - 4. The contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, tools, instruments, ladders, lifts, computers, software, cables, etc. Contractor supplied personnel must be competent with and knowledgeable of all project-specific systems, and automation hardware and software. All training documentation, submittals, installation manuals, and O&Ms, shall be at the job site before functional testing commences.
- D. Development of Test Procedures
  - 1. The CxA develops specific functional test procedures and forms to verify and document proper operation of each piece of equipment and system. The CxA provides a copy of the test procedures to the A/E, CM and installing Sub who shall review the tests prior to testing. The A/E and Sub(s) shall point out to the CxA any specific problems as related to feasibility, safety, equipment and warranty protection.
- E. Coordination and Scheduling
  - 1. The GC shall provide sufficient notice to the CxA regarding the Subs completion schedule for the prefunctional checklists and startup of all equipment and systems. The CxA will schedule functional tests after written notification from the GC and affected Subs. Completed startup testing report must be provided to CxA prior to functional testing. The CxA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.

2. In general, functional testing shall not be scheduled until all hardware and software submittals are approved, Prefunctional checklists are approved, and start-up has been satisfactorily completed. Further, mechanical system functional testing shall not be scheduled until the final TAB report is approved and all reported deficiencies by TAB firm are corrected. Scheduling of functional testing shall be done with a minimum of two weeks' notice prior to testing. Functional testing of the equipment and systems listed in Subsection 1.04 of this specification section shall not be conducted out of the presence of the CxA and CM, unless specifically approved to do so in writing by the CxA or CM. Any functional testing which occurs outside the presence of the CxA or CM without written authorization to do so will be required to be re-tested at no expense to the owner.

#### F. Test Methods

1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone data loggers.
2. Simulated Conditions. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
3. Overwritten Values. Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair dryer rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
4. Simulated Signals. Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
5. Altering Setpoints. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55° F, when the outside air temperature is above 55° F, temporarily change the lockout setpoint to be 2° F above the current outside air temperature.
6. Indirect Indicators. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during prefunctional testing.
7. Setup. Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Sub executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Sub shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.

#### G. Demonstration, Verification, and Validation

The HVAC systems demonstration shall include, at minimum, the following:

1. Heating Hot Water BTU Meter
2. Chilled Water BTU Meter
3. Variable Air Handling Units
4. Variable Air Volume Terminal Units w/ Heating Hot Water Coils
5. Fan Coil Units
6. General Building Exhaust Fans
7. Dust Collector
8. Building Automation System

H. Problem Solving

1. The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the GC, Subs and A/E.

**3.4 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS**

- A. Refer to Specification Section 019113, Subsection 3.6.

**3.5 OPERATION AND MAINTENANCE MANUALS**

- A. In addition to installation manuals, the contractor shall provide one copy of the Operation and Maintenance Manuals to the CxA for the systems to be commissioned. The O&M Manuals shall be provided to the CxA at least 8 weeks prior to the start of Functional Testing.

**3.6 TRAINING OF OWNER PERSONNEL**

- A. See Specification Section 019113, Subsection 3.8.
- B. Provide designated Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of HVAC equipment or system.
- C. CxA shall witness a sampling of the training sessions and provide approval of the content.

**3.7 DEFERRED TESTING**

- A. See Specification Section 019113, Subsection 3.9.

**APPENDIX A**

**EXAMPLE PREFUNCTIONAL CHECKLIST**

**System Name: Rooftop Package Air Conditioning Unit - x (AC-x)**

**Serves: Building x**

**Prefunctional Checklist**

**1. Verification**

Pre-functional checklist items must be completed as part of startup & initial checkout, in preparation for Functional Performance Testing. The following items are complete and the system is ready for Functional Performance Testing:

- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable).
- The prefunctional checklist items are complete and have been signed off only by parties having direct knowledge of the event.
- Contractor’s assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- “Contr.” column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item.
- This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items.
- The installation is complete and ready for functional testing.

A/E	Architect/Engineer	All	All contractors	EC	Electrical Contractor
CxA	Commissioning Agent	CC	Controls (BAS) Contractor	GC	General Contractor
MC	Mechanical Contractor	TAB	TAB Contractor	PC	Plumbing Contractor

<i>Signature:</i> _____	<i>Signature:</i> _____	<i>Signature:</i> _____
Date: _____	Date: _____	Date: _____
<i>Name:</i> _____	<i>Name:</i> _____	<i>Name:</i> _____
GC: General Contractor Company	EC: Electrical Contractor Company	MC: Mechanical Contractor Company
<i>Signature:</i> _____	<i>Signature:</i> _____	<i>Signature:</i> _____
Date: _____	Date: _____	Date: _____
<i>Name:</i> _____	<i>Name:</i> _____	<i>Name:</i> _____
TAB: Testing, Adjusting & Balancing Contractor Company	CC: Controls Contractor Company	PC: Plumbing Contractor Company

**2. Approvals**

This prefunctional checklist has been completed and is approved with the exceptions noted below.

*Signature:* \_\_\_\_\_

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

*Name:* \_\_\_\_\_

CxA: Commissioning Authority Company

### 3. Equipment Verification

Enter N/A if not applicable. Enter note or # if deficient. Attach notes to this sheet.

Equipment Specifications	As Specified	As Submitted	As Installed	Notes
Manufacturer	Carrier	Carrier		
Model Number	48TC005	48TC005		
Serial Number	N/A	N/A		
Unit Type	Rooftop Outdoor Unit	Rooftop Outdoor Unit		
Cooling Capacity (BTU/HR)	47,000	47,000		
Heating Capacity (BTU/HR)	59,040	59,040		
Supply Fan (HP)	2	2		
Supply Air Flow (CFM)	1600	1600		
Electrical (Volts/Phase/Hz)	208/3/60	208/3/60		

### 4. Installation Checks

Enter N/A if not applicable. Enter note or # if deficient. Attach notes to this sheet.

General Installation	Contractor	Check or Note or #
Unit is free of physical damage	MC	
Permanent identification (labels) affixed and visible	MC	
Unit installed as required by manufacturer and construction documents	MC	
Vibration isolators installed (if applicable)	MC	
Access acceptable for future maintenance of unit and components	MC	
Unit casing condition good (no dents, no leaks and gaskets installed)	MC	
Access doors close tightly (no leaks)	MC	
Construction filters removed	MC	
Filters installed; replacement and efficiency permanently affixed to housing	MC	
Unit is clean, free of debris	MC	
Dampers and Ductwork	Contractor	Check or Note or #
Ductwork system is complete; connections tight without leaks	MC	
Ductwork is clean and free of debris	MC	
Ductwork pressure leakage tests completed and approved	MC	
Thermal insulation installed per construction documents and no damage	MC	
Dampers operate smoothly without binding and close tight	MC	
Outside air intakes located away from pollutant sources and exhaust outlets	MC	
Valves, Piping and Coils	Contractor	Check or Note or #

Piping components installed in correct order as required by drawing details	MC	
Piping installed and arranged for ease of unit and components maintenance	MC	
Piping is flushed, free of debris and air	MC	
Thermal insulation installed per construction documents and no damage	MC	
Permanent identification (labels) affixed and visible	MC	
All valves and P/T test ports are easily accessible	MC	
Refrigerant sight glass installed in proper direction	MC	
Cooling coil is clean, fins are straight and in good condition	MC	
Condensate pan clean and sloped to drain floor drain	MC / PC	
<b>Compressor and Condenser</b>	<b>Contractor</b>	<b>Check or Note or #</b>
Compressors and piping were leak tested (provide results)	MC	
Condenser coils clean and in good condition	MC	
Adequate clearance for airflow around condenser (required by manufacturer)	MC	
Correct oil level (check site glass during normal operation)	MC	
Refrigerant sight glass clear of bubbles	MC	
<b>Supply Fan</b>	<b>Contractor</b>	<b>Check or Note or #</b>
Supply fan motor and wheel are aligned (center)	MC	
Supply fan wheel rotates freely without rubbing	MC	
Supply fan belt tension as required by manufacturer	MC	
Supply fan lubricated as required by manufacturer	MC	
<b>Electrical Installation</b>	<b>Contractor</b>	<b>Note or #</b>
All electrical connections are tight and code compliant	EC	
All electrical connections are grounded per drawings	EC	
Local disconnect switch is operational	EC	
Breaker/disconnect(s) labeled as to the circuit and equipment served	EC	
Overloads and/or fuses installed, sized and calibrated correctly	EC	
120 Volt power connection for lights and/or convenience outlets install	EC	

**5. Operational Checks**

Enter N/A if not applicable. Enter note or # if deficient. Attach notes to this sheet.

<b>Supply Fan</b>	<b>Contractor</b>	<b>Check or Note or #</b>
Motor rotation is in correct direction	MC / EC	
Breaker/disconnect(s) operates properly	EC	
Motor voltage and amps verified _____ Volts _____ Amps	EC	
Record fan Full Load Running Amps (FLA) _____ Amps. _____ rated FLA * _____ Service Factor (SF) = _____ Max. Amps. Fan running less than maximum?	EC	



Fan motor Phase checks: (%Imbalance = 100 * (Average - Lowest)/Average) Record phase to phase voltages: AB _____, AC _____, BC _____ Imbalance less than 2%?	EC	
Fan wheel starts and runs without any unusual noise or vibration	MC	
After 30-minutes operation, inspect unit bolts, screws and setscrews. Adjust and tighten as necessary.	MC	
After 8-hours operation, inspect alignment. Adjust as necessary.	MC	
Manufacturer's startup checklist completed and attached (if applicable)	MC	
<b>Testing, Adjusting and Balancing</b>	<b>Contractor</b>	<b>Check or Note or #</b>
Installation of system and balancing devices will allow balancing to be done per specified AABC procedures and construction documents	TAB	
Supply fan providing design air flows	TAB	
<b>Controls</b>	<b>Contractor</b>	<b>Check or Note or #</b>
Air handling unit's internal controls startup and point to point verified	MC	
Air handling unit's full sequence of operations is verified and operational	MC	
Fire alarm system interlocks is functioning properly	MC / EC	

**6. Notes:**

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\*Attach additional sheets if needed.

-- END OF CHECKLIST --

**APPENDIX B**

**EXAMPLE FUNCTIONAL TEST PROCEDURE**

## Functional Performance Test

### 1. System Description

- **Building:** Building x
- **System:** Rooftop Package Gas/Electric Air Conditioning Unit
- **Equipment Identification:** AC-xx
- **Make:** Carrier
- **Model:** \_\_\_\_\_
- **Serial:** \_\_\_\_\_
- **Equipment Location:** Building x Roof
- **Serves:** Building x – Suite xxx

### 2. Test Participants

Organization		Participation Capacity
General Contractor	General Contractor Company	Provide assistance as needed for corrective items. Verify that items are completed, keep track of schedule.
Mechanical Contractor	Mechanical Contractor Company	Provide testing support and NIST certified instrumentation for checks outlined herein.
Owner's O&M Personnel	Owner's Representative Company	<i>Optional</i>
Commissioning Authority	Commissioning Authority Company	Along with the controls contractor, perform the functional performance testing as Independent third party witness and documenting functional performance results.

### 3. Approvals

We the undersigned participated in this functional test, acknowledge that the functional testing process for the equipment has been completed and that noted deficiencies or corrective actions noted have been made.

Signature:	Signature:	Signature:
Date:	Date:	Date:
Name:	Name:	Name:
GC: General Contractor Company	MC: Mechanical Contractor Company	

Signature:	Signature:	Signature:
Date:	Date:	Date:
Name:	Name:	Name:
Owner: Owner's Representative Co.	CxA: Commissioning Authority Co.	

#### 4. Test Prerequisites

General Contractor to verify following items have been completed and system is ready for functional testing:

- Site checks of the prefunctional checklist and manufacturer startup reports completed successfully.
- Control system programmed and operable per contract documents, including final set points and schedules, logic debugged and control loops tuned
- Test and balance (TAB) is complete, approved and submitted to Commissioning Authority
- A/E deficiency items for this equipment are completed
- Functional Performance Test procedures have been reviewed and approved by installing contractors
- Safety controls and operating ranges are set, activated and checked

Initial Test		Start Date	End Date	Initials
Results (check one) <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Partial Test w/ Corrective Actions <input type="checkbox"/> Complete Test w/ Corrective Actions <input type="checkbox"/> Other	Explanation:			

Re-Test 1		Start Date	End Date	Initials
Results (check one) <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Partial Test w/ Corrective Actions <input type="checkbox"/> Complete Test w/ Corrective Actions <input type="checkbox"/> Other	Explanation:			

Re-Test 2		Start Date	End Date	Initials
Results (check one) <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Partial Test w/ Corrective Actions <input type="checkbox"/> Complete Test w/ Corrective Actions <input type="checkbox"/> Other	Explanation:			

#### 5. Operation Schedule

Air handling unit can be assigned to schedule

	AM											PM												
Day	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11
Sun																								
Mon																								
Tues																								
Wed																								
Thurs																								
Fri																								
Sat																								
Holi																								

### 6. Setpoint Verification

Record setpoint

Point Description	Setpoint		Adjustable Range		Note #
	Design	Actual	Design	Actual	
Space Temperature Setpoint	53				
Design Minimum Outside Airflow Setpoint	500				

### 7. Functional Testing Procedures

The Commissioning Authority will make and document any changes, additions or deletions to this test procedure required by current system conditions (i.e. weather, system load, utility availability, etc.)

Y = Checked and Passed  
N = Not Passed

R = Retest (check if retest required)  
C = Corrected (check if correction verified)

Line	Mode ID	Action	Expected Response	Y	N	Comments	R	C
1	Thermostat Cooling Settings	Design thermostat settings - Monday - Friday Occupied @ 8AM @ 74°F Unoccupied @ 5PM @ 80°F	Verify by visual inspection that - Monday - Friday Occupied @ ____ @ ____°F Unoccupied @ ____ @ ____°F	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
		Saturday - Sunday Occupied @ 8AM @ 74°F Unoccupied @ 5PM @ 80°F	Saturday - Sunday Occupied @ ____ @ ____°F Unoccupied @ ____ @ ____°F	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues:						Issue log item #:		
2	Thermostat Heating Settings	Design thermostat settings - Monday - Friday Occupied @ 8AM @ 70°F Unoccupied @ 5PM @ 64°F	Verify by visual inspection that - Monday - Friday Occupied @ ____ @ ____°F Unoccupied @ ____ @ ____°F	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
		Saturday - Sunday Occupied @ 8AM @ 70°F Unoccupied @ 5PM @ 64°F	Saturday - Sunday Occupied @ ____ @ ____°F Unoccupied @ ____ @ ____°F	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Record issues:						Issue log item #:		

3	Thermostat Heating Mode Operation	With the schedule in unoccupied mode and unit off;	Verify by visual inspection that -	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
		Set time to an occupied period then repeat in unoccupied period.	Outside air temperature above 70°F the economizer mode is disabled and outside air damper opens to "minimum" position, then supply fan "starts". After 10 seconds, compressor "starts", reversing valve is "energized", condenser fan "starts" if required and heat is supplied to the space.					
		Raise set point to 5 degrees above the ambient space temperature.	With the increased heating demand after 10 seconds the electric auxiliary heat is "energized".					
Record issues:						Issue log item #:		
4	Heating Mode Supply Air Temperature Check	With the schedule in occupied mode and unit running;	Verify by visual inspection that -	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
		Randomly take supply air temperature measurements from the respective supply diffusers.	SA Temp Measurement: _____ °F					
Record issues:						Issue log item #:		
5	Thermostat Heating Mode Off	With the schedule in occupied mode and unit running;	Verify at BAS and by visual inspection that -	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
		Lower the temperature set point to 5 degrees below the ambient space temperature.	Compressor, condenser fan, reversing valve, auxiliary electric heat, supply fan, and relief fan "stop" and outside air damper "closes".					
Record issues:						Issue log item #:		

6	Thermostat Cooling Mode with Economizer Enabled Operation	With the schedule in occupied mode and unit running;	Verify by visual inspection that -	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
		Set time to an occupied period then repeat in unoccupied period.	If outside air temperature is less than 70°F, then outside air damper opens to "maximum" position while "closing" return air damper. After the outside air damper opens past minimum position 30 seconds later the power exhaust fan "starts" and "modulates" to maintain space pressurization. Additionally upon the call for cooling the supply fan "starts".					
		Lower set point to 5 degrees below the ambient space temperature.	Upon a second call for cooling compressor "starts", condenser fan "starts" if required and cooling is supplied to the space.					
		Lower set point additional 5 degrees below the ambient space temperature.						
Record issues:						Issue log item #:		
7	Cooling Mode Supply Air Temperature Check	With the schedule in occupied mode and unit running;	Verify by visual inspection that -	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
		Randomly take supply air temperature measurements from the respective supply diffusers.	SA Temp Measurement: _____ °F					
Record issues:						Issue log item #:		
8	Thermostat Cooling Mode with Economizer Disabled Operation	With the schedule in occupied mode and unit running;	Verify at BAS and by visual inspection that -	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
		Set time to an occupied period then repeat in unoccupied period. Lower set point to 10 degrees below the ambient space temperature.	If outside air temperature is greater than 70°F, then outside air damper opens to "minimum" position. The call for cooling also has the supply fan "start". After 10 seconds, compressor "starts", condenser fan "starts" if required and cooling is supplied to the space.					
Record issues:						Issue log item #:		

9	Cooling Mode Supply Air Temperature Check	With the schedule in occupied mode and unit running;	Verify by visual inspection that -				
		Randomly take supply air temperature measurements from the respective supply diffusers.	SA Temp Measurement: _____ °F	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Record issues:	Issue log item #:				
10	Thermostat Cooling Mode Off	With the schedule in occupied mode and unit running;	Verify at BAS and by visual inspection that -				
		Raise the temperature set point to 5 degrees above the ambient room temperature.	Compressor, condenser fan, reversing valve, auxiliary electric heat, supply fan, and relief fan "stop" and outside air damper "closes".	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11	Thermostat Ventilation Mode Operation	Manually set thermostat to fan mode.	Verify by visual inspection that -				
			Outside air damper opens to "minimum" position, then supply fan "starts", and compressor, condenser fan, auxiliary electric heat, and reversing valve remains "off".	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**8. Controls Verification**

Verify the Building Management System’s operator workstation dynamic graphics reflect an actual depiction of the system’s configuration and operation.

Y = Checked and Passed  
 N = Not Passed

R = Retest (check if retest required)  
 C = Corrected (check if correction verified)

Line	Expect	Y	N	Comments	R	C
1	Air handling unit matches contract documents	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
2	Air handling unit system occupied/unoccupied modes set by scheduler and schedule shown.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>

**9. Notes:**

\* Attach additional sheets if needed.

Note: Items of non-compliance to the test requirements will be noted on the Master Commissioning Deficiency Log. The deficiency log will contain information such as date found, equipment/system involved, potential cause, responsibility and potential remedial actions. The contractor/supplier is expected to use their collective expertise to solve the problem(s) or replace defective equipment.

-- END OF TEST --

**END OF SECTION 23 08 00**



## **SECTION 23 09 00 – INSTRUMENTATION AND CONTROL FOR HVAC**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Description
- B. Approved Control System Contractor
- C. Quality Assurance
- D. Codes and Standards
- E. System Performance
- F. Submittals
- G. Warranty
- H. Ownership of Proprietary Material

#### **1.2 DESCRIPTION**

General: Long Beach City College has adopted and implemented an open, Wide area Networked (WAN) Building automation system based on the ANSI/ASHRAE standard 135 for Building Automation and Control Networks (BACnet) and a common system integration platform using Trane Ensemble. This platform allows products from various manufacturers to be considered in the expansion and support of all EMS projects implemented by Long Beach City College, while maintaining a consistent and unified system.

Every Long Beach City College facility shall consist of a distributed network of BACnet-based interoperable Direct Digital Control (DDC) devices that are configured to perform energy management and monitoring functions for all specified heating, ventilating and air-conditioning (HVAC) systems and all other sub-systems required per these specifications. These controllers shall communicate via wireless BACnet over ZigBee mesh communication protocol with the Trane Open Protocol System Controllers (SC+) for integration with the Long Beach City College WAN and to facilitate common global functions for scheduling, trending, alarming and operator interface. Access to the system, either locally in each building, or remotely from a central site, shall be accomplished through standard Web browsers via the internet and/or local area network. The system shall consist of at least one System Controller (SC+) per building for integration with the Owners WAN and to facilitate common global functions for scheduling, trending, alarming and operator interfaces, and a network of BACnet Direct Digital Controllers (DDSs) for control and monitoring of the specified systems.

Although the primary DDC network shall utilize the BACnet open protocol, it is understood that a BACnet interface may not always be available when integrating directly with peripheral devices or sub-systems. In these cases, a Modbus or LonWorks open protocol may be considered. Device integration via any protocol other than BACnet must be explicitly approved by Long Beach City College.

The system is an enterprise-level multiple building control system as indicated on the drawings and described in the specifications. Control functions within a building site shall be performed by localized direct digital controls linked through a peer-to-peer network of building controllers. The system shall provide a web-based user interface and be designed to integrate multiple BACnet-based systems together, collect, store and display historical data and provide enterprise-wide or multiple building facilities management capabilities from a central storage and operational location.

An operator shall be able to logon to the system using a standard web browser, and without requiring system vendor-proprietary software installed on the user's PC to allow access to all appropriate data and control functions.

- A. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of systems defined for control on this project.
- B. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited by operator password. An operator shall be able to log onto any workstation of the control system and have access to all designated data.
- C. The control system shall be designed such that each mechanical system will operate under stand-alone control. As such, in the event of a network communication failure, or the loss of other controllers, the control system shall continue to independently operate the unaffected equipment.
- D. Communication between the control panels and all workstations shall be over a high-speed network. All nodes on this network shall be peers. A network communications card shall be provided for each building control panel provided as part of the system installation.

### 1.3 APPROVED CONTROL SYSTEM CONTRACTORS AND MANUFACTURERS

- A. Approved Control System Contractors and Manufacturers:

Manufacturer Name	Product Line	Contractor Name/Address	Contact
Trane	Ensemble – AirFi Tracer SC+	Trane U.S. Inc. 3253 E. Imperial Hwy. Brea, CA 92821	Brad Donnelly <a href="mailto:Brad.Donnelly@trane.com">Brad.Donnelly@trane.com</a> 949-412-5790

- 1. The above list of manufacturers applies to centralized server software, operator workstation configuration tool software, building controller software, the custom application programming language, Building Controllers, Custom Application Controllers, and Application Specific Controllers. All other products specified herein (i.e., sensors, valves, dampers, and actuators) need not be manufactured by the above manufacturers.

## **1.4 QUALITY ASSURANCE**

### **A. System Installer Qualifications**

1. The Installer shall have an established working relationship with the Control System Manufacturer of not less than three years.
2. The Installer shall have successfully completed Control System Manufacturer's classes on the control system. The Installer shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.
3. The installer shall have an office within [50] miles of the project site and provide [24-hour] response in the event of a customer call.

## **1.5 CODES AND STANDARDS**

### **A. Work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of local, state and federal authorities. As a minimum, the installation shall comply with the current editions in effect 30 days prior to receipt of bids of the following codes:**

1. National Electric Code (NEC)
2. International Building Code (IBC)
3. International Mechanical Code (IMC)
4. Underwriters Laboratories: Products shall be UL-916-PAZX listed.
5. ANSI/ASHRAE Standard 135-2001 (BACnet)

## **1.6 SYSTEM PERFORMANCE**

- A. Data values displayed on web pages (that represent live data) shall automatically refresh at a minimum rate of every 10 seconds in the browser without refreshing the entire page.
- B. Data on web pages must be returned and updated on a given web page within [5] seconds on average after the web page is initially delivered, subject to network loading.
- C. Graphic Display. The system shall display a graphic with a minimum of [20] dynamic points with current data displayed within [20] seconds of the request.
- D. Graphic Refresh. The system shall update all dynamic points with current data within [30] seconds.
- E. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be [10] seconds. Analog objects shall start to adjust within [10] seconds.
- F. Object Scan. All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or workstation will be current, within the prior [60] seconds.
- G. Alarm Response Time. The maximum time from when an object goes into alarm to when it is viewable on an operator workstation web page shall not exceed [45] seconds.

- H. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every [5] seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
- I. Performance. Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every [5] seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
- J. Multiple Alarm Annunciation. Any authorized operator shall be able to view alarms through a web page interface, with up to [40] concurrent users accessing the system alarm data.
- K. Reporting Accuracy. Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.

**Table 1**  
**Reporting Accuracy**

Measured Variable	Reported Accuracy
Space Temperature	$\pm 0.5^{\circ}\text{C}$ [ $\pm 1^{\circ}\text{F}$ ]
Ducted Air	$\pm 1.0^{\circ}\text{C}$ [ $\pm 2^{\circ}\text{F}$ ]
Outside Air	$\pm 1.0^{\circ}\text{C}$ [ $\pm 2^{\circ}\text{F}$ ]
Water Temperature	$\pm 0.5^{\circ}\text{C}$ [ $\pm 1^{\circ}\text{F}$ ]
Delta-T	$\pm 0.15^{\circ}\text{C}$ [ $\pm 0.25^{\circ}\text{F}$ ]
Relative Humidity	$\pm 5\%$ RH
Water Flow	$\pm 5\%$ of full scale
Air Flow (terminal)	$\pm 10\%$ of reading *Note 1
Air Flow (measuring stations)	$\pm 5\%$ of reading
Air Pressure (ducts)	$\pm 25$ Pa [ $\pm 0.1$ "W.G.]
Air Pressure (space)	$\pm 3$ Pa [ $\pm 0.01$ "W.G.]
Water Pressure	$\pm 2\%$ of full scale *Note 2
Carbon Dioxide (CO2)	$\pm 50$ PPM

Note 1: (10%-100% of scale) (cannot read accurately below 10%)

Note 2: for both absolute and differential pressure

## 1.7 SUBMITTALS

- A. Contractor shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software to be provided. No work may begin on any segment of this project until the Engineer and Owner have reviewed submittals for conformity with the plan and specifications. [Six (6)] copies are required. All shop drawings shall be provided to the Owner electronically as .dwg or .dxf file formats.
- B. Quantities of items submitted shall be reviewed by the Engineer and Owner. Such review shall not relieve the contractor from furnishing quantities required for completion.

- C. Provide the Engineer and Owner, any additional information or data which is deemed necessary to determine compliance with these specifications or which is deemed valuable in documenting the system to be installed.
- D. Submit the following within [60] days of contract award:
1. A complete bill of materials of equipment to be used indicating quantity, manufacturer and model number.
  2. A schedule of all control valves including the valve size, model number (including pattern and connections), flow, CV, pressure rating, and location.
  3. A schedule of all control dampers. This shall include the damper size, pressure drop, manufacturer and model number.
  4. Provide manufacturers cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is being submitted to cover. Include:
    - a. Building Controllers
    - b. Custom Application Controllers
    - c. Application Specific Controllers
    - d. Configuration and service software programs
    - e. Auxiliary Control Devices
    - f. Proposed control system riser diagram showing system configuration, device locations, addresses, and cabling
    - g. Detailed termination drawings showing all required field and factory terminations. Terminal numbers shall be clearly labeled
    - h. Points list showing all system objects, and the proposed English language object names
    - i. Sequence of operations for each system under control. This sequence shall be specific for the use of the Control System being provided for this project
    - j. Color prints of proposed graphics with a list of points for display
  5. Project Record Documents. Upon completion of installation submit one (1) electronic copy of record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:
    - a. Project Record Drawings. These shall be as-built versions of the submittal shop drawings. One set of electronic media including PDF or Visio drawing files shall also be provided.
    - b. Testing and Commissioning Reports and Checklists.
    - c. Operating and Maintenance (O & M) Manual. These shall be as-built versions of the submittal product data. In addition to that required for the submittals, the O & M manual shall include:
      - 1) Names, address and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representative of each.
      - 2) Operators Manual with procedures of operating the control systems including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.

- 3) Engineering, Installation and Maintenance Manual(s) that explains how to design and install new points, panels, and other hardware; preventative maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.
  - 4) A listing and documentation of all custom software created using the programming language including the point database. One set of magnetic media containing files of the software and database shall also be provided.
  - 5) Complete original issue documentation, installation, and maintenance information for all third party hardware provided including computer equipment and sensors.
  - 6) Complete original issue media for all software provided including operating systems, programming language, operator workstation software, and graphics software.
  - 7) Licenses and warranty documents for all equipment and systems.
  - 8) Recommended preventive maintenance procedures for all system components including a schedule of tasks, time between tasks, and task descriptions.
- d. Training Materials: The Contractor shall provide a course outline and training material for all training classes at least six weeks prior to the first class. The Owner reserves the right to modify any or all of the training course outline and training materials. Review and approval by Owner and Engineer shall be completed at least 3 weeks prior to first class.

## 1.8 WARRANTY

A. Warrant all work as follows:

1. Labor & materials for control system specified shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. Control System failures during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Owner. The Contractor shall respond to the Owner's request for warranty service within 24 hours during customary business hours.
2. At the end of the final start-up/testing, if equipment and systems are operating satisfactorily to the Owner and Engineer, the Owner shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of warranty.
3. Central server and configuration tool software, project specific software, graphics, database, and firmware updates shall be provided to the Owner at no charge during warranty period. Written authorization by Owner must, however, be granted prior to the installation of such changes.
4. The system provider shall provide a web-accessible on-line resource that provides the Owner access to a question/answer forum, graphics library, user tips, upgrades, and manufacturer training schedules.

## 1.9 OWNERSHIP OF PROPRIETARY MATERIAL

- A. All project-developed hardware and software shall become the property of the Owner. These items include but are not limited to:

1. Project graphic images
2. Record drawings
3. Project database
4. Project-specific application programming code
5. All documentation

## **PART 2 - PRODUCTS**

### **2.1 SECTION INCLUDES**

- A. General Description
- B. Architecture/Communication
- C. Operator Interface
- D. Application and Control Software
- E. System Controllers
- F. Equipment Controllers
- G. Input/Output Modules
- H. Auxiliary Control Devices
- I. System Tools
- J. General Description

### **2.2 PRODUCTS INTEGRATED TO BUT NOT FURNISHED UNDER THIS SECTION**

- A. VFDs
- B. Lighting Control Panel
- C. Inverter
- D. Electrical Meter
- E. Water meter
- F. This project shall be comprised of a high speed Ethernet network utilizing BACnet/IP communications between System Controllers, Workstations and Unitary Intelligent Equipment coordinators. Communications between System Controllers and sub-networks of Custom Application Controllers and/or Application Specific Controllers shall utilize [BACnet/Zigbee] or [BACnet/MSTP (RS485)] communications. Communications of Unitary intelligent room equipment to the coordinators shall be EA certified 902mhz.( ISO/IEC 14543-3-10/11)

G. BACnet/Zigbee

1. Each System Controller shall perform communications to a network of Custom Application and Application Specific Controllers using BACnet/Zigbee (802.15.4) as defined by the Zigbee Standard.
  - a. Each communication interface shall be Zigbee Building Automation Certified product as defined by the BACnet Standard and the Zigbee Alliance.
  - b. Each System Controller shall function as a BACnet Router to each unit controller providing a unique BACnet Device ID for all controllers within the system.
2. All values within the system – contained in both the system and unit controllers - (i.e. Schedules, Data Logs, Points, Application Variables, Custom Program Variables) shall be readable and controllable (where appropriate) by any System Controller or BACnet Workstation on the communications network via BACnet.

**2.3 ARCHITECTURE/COMMUNICATION**

A. Wireless primary equipment controllers and auxiliary control devices shall conform to:

1. IEEE 802.15.4 radios to minimize risk of interference and maximize battery life, reliability, and range.
2. Communication between equipment controllers shall conform to ZigBee Building Automation (ZBA) standard as BACnet tunneling devices to ensure future integration of other ZBA certified devices.
3. Operating range shall be a minimum of 200 feet; open range shall be 2,500 ft. (762 m) with less than 2% packet error rate to ensure reliable operation.
4. To maintain robust communication, mesh networking and two-way communications shall be used to optimize the wireless network health.
5. Wireless communication shall be capable of many-to-one sensors per controller to support averaging, monitoring, and multiple zone applications.
6. Certifications shall include FCC CFR47 - RADIO FREQUENCY DEVICES - Section 15.247 & Subpart E
7. Communication between equipment controllers shall conform to ZigBee Building Automation (ZBA) standard as BACnet tunneling devices to ensure future integration of other ZBA certified devices.
8. Operating range shall be a minimum of 200 feet; open range shall be 2,500 ft. (762 m) with less than 2% packet error rate to ensure reliable operation.

B. Wireless in room unitary and ancillary control devices shall conform to:

1. Radio certification of FCC (U.S. SZV-STM300U) & C (Canada 5713A-STM300U) at 902mhz.( ISO/IEC 14543-3-10/11)
2. Operating range shall be a minimum of 60 feet; open range shall be 300ft with less than 2% packet error rate to ensure reliable operation.
3. Wireless in room devices must be able to be fully configured with the intended application through a wireless connection direct to the device utilizing ISO/IEC 14543-3-10/11 compliant communications by easy to use windows based configuration tools.



4. In room unitary equipment coordinators must conform to both Bacnet IP BTL standards as well as EA 2.0/3.0 and must be capable of POE and 802.11.g/f wireless communications
5. Coordinators must be able to automatically generate appropriate BACnet IP compliant messages from the in room unitary controls. Devices that require manual device input and output programming and BACnet message correlation table entries will not be accepted.
6. Wireless operating range shall be a minimum of 30 feet; open range shall be 200 ft. with less than 2% packet error rate to ensure reliable operation.
7. Unitary edge devices must be wireless, maintenance free and must not rely on batteries.

C. Wireless Space Sensors

1. Battery life shall be 15 years or greater to minimize the need for battery replacement in typical operating conditions.
2. To check for proper operation, wireless space temperature sensors shall include a signal strength on the space sensor display.
3. To allow local troubleshooting without specialized tools, error codes shall be displayed on the digital display. Error codes shall include: not associated, address to 000, improper software configuration, input voltage too high, or general sensor failure. Codes shall be indicated on inside of sensor back cover.
4. To support use by the physically impaired, the wireless space sensor shall be a minimum font size of 12 points, and the LCD model shall be readable in low light conditions.
5. An optional 2% relative humidity sensors module shall be available for humidity control applications to minimize the need for wires sensors, and shall not shorten typical battery life to less than 15 years.

## 2.4 OPERATOR INTERFACE

A. Operator Interface

1. The operator interface shall be accessible via a web browser without requiring any “plug-ins” (i.e. JAVA Runtime Environment (JRE), Adobe Flash).
2. The operator interface shall support the following Internet web browsers:
  - a. Internet Explorer 10.0+
  - b. Firefox 29.0+
  - c. Chrome 35.0+
3. The operator interface shall support the following mobile web browsers:
  - a. iOS (iPad/iPhone) V7.0+
  - b. Android (Tablet) V4.3+
  - c. Android (Phone) V2.3+

B. System Security

1. Each operator shall be required to login to the system with a user name and password in order to view, edit, add, or delete data.
2. User Profiles shall restrict the user to only the objects, applications, and system functions as assigned by the system administrator.

3. Each operator shall be allowed to change their user password
4. The System Administrator shall be able to manage the security for all other users
5. The system shall include pre-defined “roles” that allow a system administrator to quickly assign permissions to a user.
6. User logon/logoff attempts shall be recorded.
7. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.
8. All system security data shall be stored in an encrypted format.

C. Database

1. Database Save. A system operator with the proper password clearance shall be able to archive the database on the designated operator interface PC.
2. Database Restore. The system operator shall also be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.

D. On-Line Help and Training

1. Provide a context sensitive, on line help system to assist the operator in operation and configuration of the system.
2. On-line help shall be available for all system functions and shall provide the relevant data for each particular screen.

E. System Diagnostics

1. The system shall automatically monitor the operation of all network connections, building management panels, and controllers.
2. The failure of any device shall be annunciated to the operators.

F. Equipment & Application Pages

1. The operator interface shall include standard pages for all equipment and applications. These pages shall allow an operator to obtain information relevant to the operation of the equipment and/or application, including:
  - a. Animated Equipment Graphics for each major piece of equipment and floor plan in the System. This includes:
    - 1) If applicable, each Chiller, Air Handler, VAV Terminal, Fan Coil, Boiler, and Cooling Tower. These graphics shall show all points dynamically as specified in the points list.
    - 2) Animation capabilities shall include the ability to show a sequence of images reflecting the position of analog outputs, such as valve or damper positions. Graphics shall be capable of launching other web pages.
  - b. Alarms relevant to the equipment or application without requiring a user to navigate to an alarm page and perform a filter.
  - c. Historical Data (As defined in Data Log section below) for the equipment or application without requiring a user to navigate to a Data Log page and perform a filter.

- G. System Graphics. Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using colors to represent zone temperature relative to zone set point.
1. Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point and-click navigation between zones or equipment, and to edit set points and other specified parameters.
  2. Graphic imagery – graphics shall use 3D images for all standard and custom graphics. The only allowable exceptions will be photo images, maps, schematic drawings, and selected floor plans.
  3. Animation. Graphics shall be able to animate by displaying different Image lies for changed object status.
  4. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.
  5. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X and Macromedia Flash).
- H. Custom Graphics
1. The operator interface shall be capable of displaying custom graphics in order to convey the status of the facility to its operators.
  2. Graphical Navigation. The operator interface shall provide dynamic color graphics of building areas, systems and equipment.
  3. Graphical Data Visualization. The operator interface shall support dynamic points including analog and binary values, dynamic text, static text, and animation files.
  4. Custom background images. Custom background images shall be created with the use of commonly available graphics packages such as Adobe Photoshop. The graphics generation package shall create and modify graphics that are saved in industry standard formats such as GIF and JPEG.
- I. Graphics Library. Furnish a library of standard HVAC equipment such as chillers, air handlers, terminals, fan coils, unit ventilators, rooftop units, and VAV boxes, in 3-dimensional graphic depictions. The library shall be furnished in a file format compatible with the graphics generation package program.
- J. Manual Control and Override.
1. Point Control. Provide a method for a user to view, override, and edit if applicable, the status of any object and property in the system. The point status shall be available by menu, on graphics or through custom programs.
  2. Temporary Overrides. The user shall be able to perform a temporary override wherever an override is allowed, automatically removing the override after a specified period of time.
  3. Override Owners. The system shall convey to the user the owner of each override for all priorities that an override exists.

4. Provide a specific icon to show timed override or operator override, when a point, unit controller or application has been overridden manually.

**K. Engineering Units**

1. Allow for selection of the desired engineering units (i.e. Inch pound or SI) in the system.
2. Unit selection shall be able to be customized by locality to select the desired units for each measurement.
3. Engineering units on this project shall be IP or SI.

**L. Scheduling.** A user shall be able to perform the following tasks utilizing the operator interface:

1. Create a new schedule, defining the default values, events and membership.
2. Create exceptions to a schedule for any given day.
3. Apply an exception that spans a single day or multiple days.
4. View a schedule by day, week and month.
5. Exception schedules and holidays shall be shown clearly on the calendar.
6. Modify the schedule events, members and exceptions.

**M. Data Logs**

1. Data Logs Definition.

- a. The operator interface shall allow a user with the appropriate security permissions to define a Data Log for any data in the system.
- b. The operator interface shall allow a user to define any Data Log options as described in the Application and Control Software section.

2. Data Log Viewer.

- a. The operator interface shall allow Data Log data to be viewed and printed.
- b. The operator interface shall allow a user to view Data Log data in a text-based format (time –stamp/value).
- c. The operator shall be able to view the data collected by a Data Log in a graphical chart in the operator interface.
- d. Data Log viewing capabilities shall include the ability to show a minimum of 5 points on a chart.
- e. Each data point data line shall be displayed as a unique color.
- f. The operator shall be able to specify the duration of historical data to view by scrolling and zooming.
- g. The system shall provide a graphical trace display of the associated time stamp and value for any selected point along the x-axis.

3. Export Data Logs.

- a. The operator interface shall allow a user to export Data Log data in CSV or PDF format for use by other industry standard word processing and spreadsheet packages.

**N. Alarm/Event Notification**

1. An operator shall be notified of new alarms/events as they occur while navigating through any part of the system via an alarm icon.
  2. Alarm/Event Log. The operator shall be able to view all logged system alarms/events from any operator interface.
    - a. The operator shall be able to sort and filter alarms from events. Alarms shall be sorted in a minimum of 4 categories based on severity.
    - b. Alarm/event messages shall use full language, easily recognized descriptors.
    - c. An operator with the proper security level may acknowledge and clear alarms/events.
    - d. All alarms/events that have not been cleared by the operator shall be stored by the building controller.
    - e. The alarm/event log shall include a comment field for each alarm/event that allows a user to add specific comments associated with any alarm.
  3. Alarm Processing.
    - a. The operator shall be able to configure any object in the system to generate an alarm when transitioning in and out of a normal state.
    - b. The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.
- O. Reports and Logs.
1. The operator interface shall provide a reporting package that allows the operator to select reports.
  2. The operator interface shall provide the ability to schedule reports to run at specified intervals of time.
  3. The operator interface shall allow a user to export reports and logs from the building controller in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Acceptable formats include:
  4. CSV, HTML, XML, PDF
  5. Reports and logs shall be readily printed to the system printer.
  6. Provide a means to list and access the last 10 reports viewed by the user.
  7. The following standard reports shall be available without requiring a user to manually configure the report:
    - a. All Points in Alarm Report: Provide an on demand report showing all current alarms.
    - b. All Points in Override Report: Provide an on demand report showing all overrides in effect.
    - c. Commissioning Report: Provide a one-time report that lists all equipment with the unit configuration and present operation.
    - d. Points report: Provide a report that lists the current value of all points
- P. Air Handler Unit/RTU System. An operator shall be able to view and control (where applicable) the following parameters via the operator interface:
1. System Mode
  2. System Occupancy
  3. Ventilation (Outdoor air flow) setpoint

4. Ventilation (Outdoor air flow) status
5. Air Handler Static pressure setpoint
6. Air Handler Static pressure status
7. Air Handler occupancy status
8. Air Handler Supply air cooling and heating set points
9. Air Handler minimum, maximum and nominal static pressure setpoints
10. VAV box minimum and maximum flow
11. VAV box drive open and close overrides
12. VAV box occupancy status
13. VAV box Airflow to space
14. Average space temperature
15. Minimum space temperature
16. Maximum space temperature

## 2.5 APPLICATION AND CONTROL SOFTWARE

- A. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator interface.
1. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, optimal stop, and night economizer actions. Each schedule may consist of up to [10] events. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of the following:
    - a. Weekly Schedule. Provide separate schedules for each day of the week.
    - b. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. This exception schedule shall override the standard schedule for that day. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed it will be discarded and replaced by the standard schedule for that day of the week.
    - c. Holiday Schedules. Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.
    - d. Optimal Start. The scheduling application outlined above shall support an optimal start algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate sets of heating and cooling rates for zones that have been unoccupied for less than and greater than 24 hours. Provide the ability to modify the start algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.
  2. Data Log Application
    - a. Data Log data shall be sampled and stored on the System Controller panel and shall be capable of being archived to a BACnet Workstation for longer term storage.

- 1) Data Log sample types shall include interval, start-time, and stop-time.
- 2) Data Log intervals shall be configurable as frequently as 1 minute and as infrequently as 1 year.

b. Data Logs

- 1) The system controller shall contain Data Log information for defined key measurements for each controlled HVAC device and HVAC application.
- 2) The Data Logs shall monitor these parameters for a minimum of 7 days at 15 minute intervals. The Data Logs intervals shall be user adjustable.
- 3) The following is a list of key measurements required to be data logged:

a) Air Systems

Air Handling Unit/Rooftop (VAV)	Discharge Air Temperature
	Discharge Air Temperature Setpoint Active
	Space Temperature Active
	Cooling Capacity Status
	Discharge Air Flow

VAVs	Discharge Air Temperature
	Space Temperature Active
	Space Temperature Setpoint Active
	Air Flow setpoint Active
	Discharge Air Flow

FCUs	
	Space Temperature Active

b) Area

Variable air system	Duct static Optimization duct static setpoint
	Duct Pressure Optimization Maximum
	Space Temperature Average
	Operating Modes

3. Point-list

- a. Provide a point list section per system. Point list should contain points required to implement control sequences specified. Point list should identify points related to alarms and trends. In addition to control points, provide additional monitoring points listed in point schedules of defined in controls sequences.

B. Alarm/Event Log

1. Any object in the system shall be configurable to generate an alarm when transitioning in and out of a normal or fault state.

2. Any object in the system shall allow the alarm limits, warning limits, states, and reactions to be configured for each object in the system.
3. An alarm/event shall be capable of triggering any of the following actions:
  - a. Route the alarm/event to one or more alarm log
    - 1) The alarm message shall include the name of the alarm location, the device that generated the alarm, and the alarm message itself.
  - b. Route an e-mail message to an operator(s)
  - c. Log a data point(s) for a period of time
  - d. Run a custom control program
4. Air Handling Unit/RTU System Coordination. Provide applications software to properly coordinate and control the AHU system to ensure equipment safety and minimize energy use. This application shall perform the following functions:
  - a. Startup and shutdown the air handler safely.
  - b. Ventilation Optimization (ASHRAE 62) – properly ventilate all spaces while minimizing operating energy costs, using measured outdoor air flow. Dynamically calculate the system outdoor air requirement based on “real time” conditions in the spaces (i.e., number of occupants, CO2 levels, etc.) minimizing the amount of unconditioned outdoor air that must be brought into the building.
  - c. Demand Controlled Ventilation – the active ventilation setpoint shall modulate between the occupied ventilation and occupied standby ventilation setpoint; Reset the setpoint based on CO2 levels in the space.
5. Point Control. User shall have the option to set the update interval, minimum on/off time, event notification, custom programming on change of events.
6. Timed Override. A standard application shall be utilized to enable/disable temperature control when a user selects on/cancel at the zone sensor, operator interface, or the local operator display. The amount of time that the override takes precedence will be selectable from the operator interface.
7. Anti-Short Cycling. All binary output points shall be protected from short cycling

## 2.6 SYSTEM CONTROLLERS

- A. There shall be one or more independent, standalone microprocessor based System Controllers to manage the global strategies described in Application and Control Software section.
  1. The controller shall provide a USB communications port for connection to a PC.
  2. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
  3. All System Controllers shall have a real time clock and shall be able to accept a BACnet time synchronization command for automatic time synchronization.
  4. Data shall be shared between networked System Controllers.
  5. Serviceability – The System Controller shall have a display on the main board that indicates the current operating mode of the controller.



6. BACnet Test Labs (BTL) Listing. Each System Controller shall be listed as a Building Controller (B-BC) by the BACnet Test Labs.
7. Remote Access / Network Security – Controls manufacture shall provide secure remote access to the Building Automation System (BAS).
  - a. Secure remote access to the BAS shall be available anywhere, anytime, using a compatible client device (PC/tablet/phone).
  - b. Secure remote access to the BAS shall be maintained by controls manufacturer.
  - c. Secure remote access to the BAS shall not require additional software to be installed on the client device (i.e. VPN client).
  - d. Secure remote access to the BAS shall not require ANY inbound ports on a firewall to be “exposed” or “forwarded”.

## **2.7 ADVANCED APPLICATION CONTROLLERS**

- A. Advance Application Controllers shall be used to control all equipment or applications of medium and high complexity, including but not limited to Air Handlers, Boiler Plants and Chiller Plants.
- B. For Stand-Alone Operation of Advanced Application Controllers:
  1. Shall operate a schedule in a standalone application using a Real Time Clock with a 7 day power backup.
    - a. The Controller shall have a built in schedule (assessable with or without a display)
    - b. Support will be for at least 3 schedules with up to 10 events for each day of the week.
    - c. Each of the 3 schedules can be Analog, Binary or Multi-State
    - d. The controller shall support a minimum of 25 exceptions each with up to 10 events.
- C. For ease of troubleshooting, the Controller shall support BACnet data trend logging.
  1. With a minimum of 20,000 trending points total on a controller.
  2. Trends shall be capable of being collected at a minimum sample rate of once every second
  3. Shall be capable of trending all BACnet points used by controller
  4. Trends shall be capable of being scheduled or triggered.
- D. To meet the sequence of operation for each application, the Controller shall use library programs provided by the controller manufacturer that are either factory loaded or downloaded with service tool to the Controller.
- E. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.
  1. Operating conditions:
    - a. Temperature: -40°F to 158°F (-40°C to 70°C)
    - b. Relative Humidity: 5% to 100% RH (non-condensing)
  2. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum.

3. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° F to 158° F [-40° C to 70° C].
- F. Input/Output: The Controller shall have on board or through expansion module all I/O capable of performing all functionality needed for the application. Controls provided by the equipment manufacture must supply the required I/O for the equipment. In addition other controls must meet the following requirements:
1. Shall support flexibility in valve type, the controllers shall be capable of supporting the following valve control types: 0-10VDC, 0-5VDC, 4-20mA, 24VAC - 2 position.
  2. Shall support flexibility in sensor type, the Controller shall be capable of reading sensor input ranges of 0 to 10V, 0 to 20mA, 50ms or longer pulses, 200 to 20Kohm and RTD input.
  3. Shall support flexibility in sensor type, all Analog Outputs shall have the additional capability of being programmed to operate as Universal Inputs or Pulse Width Modulation Outputs.
  4. Shall support flexibility in sensor type, the Controller and/or expansion modules shall support dry and wetted (24VAC) binary inputs.
  5. The controller shall support pulse accumulator for connecting devices like energy meters.
  6. In order to support a wide range of devices, the Controller's binary output shall be able to drive at least 10VA each.
  7. For future needs, any unused I/O that is not needed for the functionality of the equipment shall be available to be used by custom programs on the Controller and by any other controller on the network.
  8. The Controller shall provide 24VAC and 24VDC power terminals sensors and other devices required.
    - a. The Controller shall provide a dedicated static pressure input.
- G. Input/Output Expandability – The Controller shall provide the following functionality in order to meet current and future application needs:
1. For the application flexibility, the Controller shall be capable of expanding to a total of at least 100 hardware I/O terminations.
  2. Expansion I/O can be mounted up to 650 ft. (200m) from control.
  3. For optimized system operation, expansion I/O must communicate via an internal controller communication bus (point expansion via the BACnet MS/TP network is not allowed).
- H. Serviceability – The Controller shall provide the following in order to improve serviceability of the Controller.
1. Diagnostic LEDs for power/normal operation/status, BACnet communications, sensor bus communications, and binary outputs. All wiring connections shall be clearly labeled and made to be field removable.
  2. Binary and analog inputs and outputs shall use removable connectors or be connected to terminal strip external to the control box.
  3. Software service tool connection through all of the following methods: direct cable connection to the Controller, connection through another controller on BACnet link and through the Controller's zone sensor.

4. For safety purposes, the controller shall be capable of being powered by a portable computer's USB port for the purposes of configuration, programming and testing programs so that this work can be accomplished with the power off to the associated equipment.
  5. The Controller software tool service port shall utilize standard off-the-shelf USB printer cable.
  6. Capabilities to temporarily override the BACnet point values with built-in time expiration in the Controller.
  7. To aid in service replacement, the Controller shall easily attached to standard DIN rail mounting.
  8. For future expansion, the Controller shall be capable of adding sequence of operation programming utilizing service tools software with a graphical programming interface (editing or programming in line code is not permissible).
  - 9.
  10. To aid in service replacement, the Controller shall allow for setting its BACnet address via controller mounted rotary switches that correspond to the numerical value of the address. (DIP switch methodologies are not allowed). Setting of the address shall be accomplished without the need of a service tool or power applied to the controller.
  11. Controller data shall be maintained through a power failure
- I. Software Retention: All Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.
- J. Controller must meet the following Agency Compliance:
1. UL916 PAZX, Open Energy Management Equipment
  2. UL94-5V, Flammability
  3. FCC Part 15, Subpart B, Class B Limit
  4. BACnet Testing Laboratory (BTL) Listed

## **2.8 APPLICATION-SPECIFIC CONTROLLERS**

- A. Application Specific Controllers (ASC) shall be microprocessor-based DDC controllers which, through hardware or firmware design, control specified equipment. They are not user programmable, but are customized for operation within the confines of the equipment they are designed to serve.
- B. Zone Controllers are controllers that operate equipment that control the space temperature of single zone. Examples are controllers for VAV, Fan coil, Blower Coils, Unit Ventilators, Heat Pumps, and Water Source Heat Pumps.
- C. Software
1. To meet the sequence of operation for each zone control, the controller shall use programs developed and tested by the controller manufacturer that are either factory loaded or downloaded with service tool to the controller.
  2. Stand-Alone Operation: Each piece of equipment specified in section "A" shall be controlled by a single controller and provide stand-alone control in the event of communication failure. In case of communications failure stand-alone operation shall use

default values or last values for remote sensors read over the network such as outdoor air temperature.

3. For controlling ancillary devices and for flexibility to change the sequence of operation in the future, the controller shall be capable running custom programs written in a graphical programming language.
- D. Environment: Controller hardware shall be suitable for the anticipated ambient conditions.
1. Storage: -55° to 203° F (-48° to 95° C) and 5 to 95% Rh, non-condensing.
  2. Operating: -40° to 158° F (-40 to 70° C) and 5 to 95% Rh, non-condensing.
  3. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum.
  4. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° to 158° F [-40° to 70° C].
- E. Input/Output:
1. For flexibility in selection and replacement of valves, the controllers shall be capable of supporting all of the following valve control types 0-10VDC, 0-5VDC, 4-20mA, 24VAC floating point, 24VAC - 2 position (Normally Open or Normally Closed).
  2. For flexibility in selection and replacement of sensors, the controllers shall be capable of reading sensor input ranges of 0 to 10V, 0 to 20mA, pulse counts, and 200 to 20Kohm.
  3. For flexibility in selection and replacement of binary devices, the controller shall support dry and wetted (24VAC) binary inputs.
  4. For flexibility in selection and replacement devices, the controller's shall have binary output which are able to drive at least 12VA each.
  5. For flexibility in selection and replacement of motors, the controller shall be capable of outputting 24VAC (binary output), DC voltage (0 to 10VDC minimum range) and PWM (in the 80 to 100 Hz range).
  6. For future needs, any I/O that is unused by functionality of equipment control shall be available to be used by custom program on the controller and by another controller on the network.
  7. For future expansion and flexibility, the controller shall have either on board or through expansion, 20 hardware input/output points. Expansion points must communicate with the controller via an internal communications bus. Expansion points must be capable of being mounted up to 650ft. (200 m) from the controller. Expansion points that require the BACnet network for communication with the controller are not allowed.
- F. Serviceability – The controller shall provide the following in order to improve serviceability of the controller.
1. Diagnostic LEDs shall indicate correct operation or failures/faults for all of the following: power, sensors, BACnet communications, and I/O communications bus.
  2. All binary output shall have LED's indicating the output state.
  3. All wiring connectors shall removable without the use of a tool.
  4. Software service tool connection through all of the following methods: direct cable connection to the controller, connection through another controller on BACnet link and through the controller's zone sensor.
  5. For safety purposes, the controller shall be capable of being powered by a portable computer for the purposes of configuration, programming, and testing programs so that this work can be accomplished with the power off to the equipment.

6. Capabilities to temporarily override of BACnet point values with built-in time expiration in the controller.
7. BACnet MAC Address shall be set using decimal (0-9) based rotary switches.
8. Configuration change shall not be made in a programming environment, but rather by a configuration page utilizing dropdown list, check boxes, and numeric boxes.
9. For ease of troubleshooting, the Controller shall support BACnet data trend logging.
  - a. With a minimum of 20,000 trending points total on controller
  - b. Trends shall be capable of being collected at a minimum sample rate of once every second.
  - c. Shall be capable of trending all BACnet points used by controller
  - d. Trends shall be capable of being scheduled or triggered
10. Software Retention: All Zone Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.
11. Agency Approval: The controller shall have meet the Agency Compliance:
  - a. UL916 PAZX, Open Energy Management Equipment
  - b. UL94-5V, Flammability
  - c. FCC Part 15, Subpart B, Class B Limit

## **2.9 INPUT / OUTPUT INTERFACE**

- A. Hardwired inputs and outputs may tie into the system through building, custom application, or ASCs.
- B. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.
- C. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against the effects of contact bounce and noise. Binary inputs shall sense “dry contact” closure without external power (other than that provided by the controller) being applied.
- D. Pulse accumulation input objects. This type of object shall conform to all the requirements of binary input objects and also accept up to 10 pulses per second for pulse accumulation.
- E. Analog inputs shall allow the monitoring of low voltage (0 to 10 VDC), current (4 to 20 mA), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
- F. Binary outputs shall provide for on/off operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on building and custom application controllers shall have status lights. Outputs shall be selectable for either normally open or normally closed operation.

- G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10VDC or a 4 to 20 mA signal as required to provide proper control of the output device. Analog outputs shall not exhibit a drift of greater than 0.4% of range per year.
- H. Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices shall be limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation, etc.). Control algorithms shall run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
- I. System Object Capacity. The system size shall be expandable to at least twice the number of input/ output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system.

## 2.10 AUXILIARY CONTROL DEVICES

- A. Wireless space sensors for use in Heating, Ventilating, and Air Conditioning (HVAC) systems  
Temperature and Humidity Range
  - 1. The ambient operating temperature range for the wireless space sensor shall be 32 to 122°F (0 to 50°C).
  - 2. The ambient storage temperature range for the wireless space sensor shall be -40 to 185°F (-40 to 85°C).C.
  - 3. The ambient operating and storage humidity range for the wireless space sensor shall be 5 to 95%, non-condensing.
    - a. Components
      - 1) Wireless space sensors shall be available as: temperature only, field configurable model with digital display, and optional 2% humidity module for use in either model above. The field configurable model shall all allow field configuration without a field service tool. Configuration options include: setpoint, override pushbuttons, fan speed, and system mode switches. System mode, fan speed and setpoint shall include a lock option. The digital display shall also be field configurable to display in Fahrenheit or Celsius units of measure, and can also be configured to display setpoint only.
      - 2) The wireless space sensor addresses shall be held in non-volatile memory to ensure operation through system voltage disturbances and to minimize the risk of incorrect association.
      - 3) The wireless space sensor shall be addressed using pushbuttons and display with numerical indication to simplify and reduce installation time and minimize risk of incorrect addressing. Two position DIP switches are not acceptable.
      - 4) Installation and replacement of failed sensors shall be accomplished automatically after power up.
      - 5) The wireless space sensor shall include security screws to protect against theft.

- 6) Wireless space sensor component certifications shall include:
  - a) TFP-13651127 - Canada Compliance
  - b) UL 916 - Energy Management Equipment
  - c) UL 94 - The Standard for Flammability of Plastic Materials for Parts in Devices and Appliances: 5 VA flammability rating
  - d) UL 873 - Temperature regulating and indicating equipment
- b. Accuracy
  - 1) To ensure proper system performance, the wireless space sensors shall automatically determine when the space temperature is rapidly changing. When the space temperature is readily changing, the space temperature shall be transmitted at least once each 30 seconds. The maximum time between transmissions shall be 15 minutes. Space temperature sensing accuracy shall be +/- 0.5F (+/- 0.28C).
- c. Power Requirements
  - 1) The wireless space sensor battery life shall provide at least 15 years life under normal operating conditions and must be readily available size AA, 1.5V.
- B. Wireless Communications Interface for use in Heating, Ventilating, and Air Conditioning (HVAC) systems
  1. Temperature and Humidity Range
    - a. The ambient storage temperature range for the wireless communications interface shall be -40 to 185°F (-40 to 85°C).C.
    - b. The ambient operating and storage humidity range for the wireless communications interface shall be 5 to 95%, non-condensing.
  2. Components
    - a. The wireless communications interface shall be addressed using rotary switches with numerical indication to simplify and reduce installation time and minimize risk of incorrect addressing. Two position DIP switches are not acceptable.
    - b. Wireless Comm Interface certifications shall include:
      - 1) TFP-13651127 - Canada Compliance
      - 2) UL 916 - Energy Management Equipment
      - 3) UL 94 - The Standard for Flammability of Plastic Materials for Parts in Devices and Appliances: 5 VA flammability rating
      - 4) UL 873 - Temperature regulating and indicating equipment
      - 5) ZigBee Building Automation, BACnet Tunneling Device
- C. Motorized dampers, unless otherwise specified elsewhere, shall be as follows:
  1. Damper frames shall be 16 gauge galvanized sheet metal or 1/8" extruded aluminum with reinforced corner bracing.

2. Damper blades shall not exceed 8" in width or 48" in length. Blades are to be suitable for medium velocity performance (2,000 fpm). Blades shall be not less than 16 gauge.
  3. Damper shaft bearings shall be as recommended by manufacturer for application.
  4. All blade edges and top and bottom of the frame shall be provided with compressible seals. Side seals shall be compressible stainless steel. The blade seals shall provide for a maximum leakage rate of 10 CFM per square foot at 2.5" w.c. differential pressure.
  5. All leakage testing and pressure ratings will be based on AMCA Publication 500.
  6. Individual damper sections shall not be larger than 48" x 60". Provide a minimum of one damper actuator per section.
- D. Control dampers shall be parallel or opposed blade types as scheduled on drawings.
- E. Electric damper/valve actuators
1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
  2. Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.
  3. All rotary spring return actuators shall be capable of both clockwise or counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.
  4. Proportional actuators shall accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.
  5. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.
  6. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
  7. Actuators shall be Underwriters Laboratories Standard 873 listed.
  8. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.
- F. Control Valves
1. For modulating three-way valves and on/off applications:
    - a. Control valves shall be two-way or three-way type for two-position or modulating service as scheduled or shown.
    - b. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
      - 1) Water Valves:
        - a) Two-way: 150% of total system (pump) head.
        - b) Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
      - 2) Steam Valves: 150% of operating (inlet) pressure.
  2. For modulating two-way valves (pressure independent modulating control valves):



3. Control valves: Factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
4. Modulating control valves shall be of "pressure independent" to supply a specific flow for each degree of opening regardless of system pressure fluctuations.
5. Control valve shall accurately control flow from 0 to 100% full rated flow with an equal percentage of flow characteristic. Flow shall not vary plus/minus 5% due to system pressure fluctuations across valve with minimum of 5psi across valve.
6. Combination of actuator and valve shall provide minimum close-off pressure rating of 200 psi.
7. Actuators shall be mounted on valves at factory.
8. Multi-turn actuators are not acceptable.
9. Manufacturer shall warranty components for a period of 5 years from date of production.

**G. Binary Temperature Devices**

1. Low-voltage space thermostat shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C to 30°C (55°F to 85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
2. Line-voltage space thermostat shall be bimetal-actuated, open contact type, or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listed for electrical rating, concealed setpoint adjustment, 13°C to 30°C (55°F to 85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
3. Low-limit thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type, with an element of 6 m (20 ft) minimum length. Element shall respond to the lowest temperature sensed by any 30 cm (1 ft) section. The low-limit thermostat shall be manual reset only.

**H. Wired Temperature Sensors**

1. Temperature sensors shall be RTD or thermistor.
2. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m<sup>2</sup> (10 ft<sup>2</sup>) of duct cross section.
3. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed. The well must withstand the flow velocities in the pipe.
4. Space sensors shall be equipped with setpoint adjustment, override switch, display, and/or communication port as shown on plans.
5. Provide matched temperature sensors for differential temperature measurement.

**I. Static Pressure Sensors**

1. Sensor shall have linear output signal. Zero and span shall be field-adjustable.
2. Sensor sensing elements shall withstand continuous operating conditions plus or minus 50% greater than calibrated span without damage.
3. Water pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Sensor shall be complete with 4-20 ma output, required mounting brackets, and block and bleed valves. Mount in location accessible for service.
4. Water differential pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (DP) and maximum static pressure shall

be 3,000 psi. Transmitter shall be complete with 4-20 ma output, required mounting brackets, and five-valve manifold. Mount in a location accessible for service.

J. Low Limit Thermostats

1. Safety low limit thermostats shall be vapor pressure type with an element 6m [20 ft] minimum length. Element shall respond to the lowest temperature sensed by any one foot section.
2. Low limit shall be manual reset only.

K. Carbon Dioxide Sensors

1. Carbon Dioxide sensors shall measure CO<sub>2</sub> in PPM in a range of 0-2000 ppm. Accuracy shall be +/- 3% of reading with stability within 5% over 5 years. Sensors shall be duct or space mounted as indicated in the sequence of operation.

L. BTU meter & Hydronic Flow meter

1. Performance Requirements: Manufacturer shall certify that each energy meter indicated complies with specified performance requirements and characteristics
  - a. Thermal energy meters, utilizing either full-bore inline electromagnetic type flow meter or insertion electromagnetic type flow meters:
    - 1) Manufacturers: Subject to compliance with requirements, provide products by one of the followings:
      - a) Onicon System-10 BTU meter
      - b) Or approved by the engineer of record
2. Factory-packaged meter consisting of a matched set of supply and return chilled water temperature sensors, flow sensor, digital display, operator interface, installation hardware, interconnecting cabling, and installation instructions. Each thermal energy meter shall be individually calibrated and provided with calibration certifications traceable to NIST.
3. Alphanumeric display of the following on face of enclosure:
  - a. Total energy consumption.
  - b. Energy rate.
  - c. Flow rate.
  - d. Supply temperature.
  - e. Return temperature
4. Diagnostic Lights:
  - a. Meter equipped with diagnostic indicator lights that confirm the operation of the microprocessor and its input circuitry.
  - b. Red LED labeled "BTU" shall flash as energy is transferred.
  - c. Red LED labeled "FLOW" shall flash at a rate that is proportional to the liquid flow rate. An unlit LED indicates no flow signal.

5. Programming:
  - a. Meter shall be factory programmed for specific application.
  - b. Programmed parameters and total energy consumption shall be stored in non-volatile memory.
6. Output Signals:
  - a. Factory-set isolated analog output for energy rate, flow rate, or temperature difference: 4 to 20 mA, zero to 10 V.
  - b. Network communication interface serial communication interface: compatible with host to share total energy consumption, energy rate, flow rate, and supply and return temperature data
7. Temperature Sensors:
  - a. Temperature range matched to application.
  - b. Differential temperature accuracy within 0.15 deg F over the calibrated range.
  - c. One temperature sensor shall be built into the body of the flow sensor.
  - d. Second sensor shall be provided with brass thermowell with NPS 1/2 sweat fitting or NPS 1/4 NPT connection.
8. Flow Sensor:
  - a. Refer to section (m) for flow meters
  - b. Furnish with two tail pieces to facilitate connection to the piping system. One end of each tail piece shall be a compression fitting with retaining nut, and the other end shall either be a sweat fitting for copper or a threaded nipple with NPT threads.
  - c. House electronics in a NEMA 250, Type 4 weathertight aluminum enclosure with a gasketed cover. Housing shall include connection for field installed conduit.
  - d. Sensor cable length shall be sufficient to connect to display module.
9. Power Supply:
  - a. Field Power: 24-V ac, 50 or 60 Hz unless otherwise required by the application.

M. Flow meters

1. Inline Full Bore Electromagnetic Flow meters:
  - a. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
    - 1) Onicon F-3500 Series Electromagnetic Flow Meter (Basis of Design)
    - 2) Engineer Approved Equal
  - b. Description: Flow meter with sensor, fittings, indicator, and electronic interface.
    - 1) No Moving Parts

- 2) Wet calibrate and tag meters to standards traceable to NIST and provide each meter with a certificate of calibration.
  - 3) Connections to piping shall be ANSI class 150 flanges, the installing contractor shall provide suitable mating flanges.
2. Flow Range: Sensor and indicator shall cover operating range of equipment or system served and shall be reprogrammable using the integral keypad on the converter (no special interface device or computer required). Refer to BTU meter schedule.
  3. Sensor: Loop powered current based.
    - a. Design: electromagnetic measurement for water flow.
    - b. Construction: 316 Stainless Steel.
  4. Permanent Indicators: Meter suitable for wall or bracket mounting, and copper tubing for connecting to sensor.
    - a. Scale: Gallons per minute.
    - b. Accuracy: Plus or minus 0.2 percent from 1.6 to 33 ft/s, and 0.01 ft/s at flows less than 1.6 ft/s.
  5. Conversion Chart: Flow rate data compatible with sensor and indicator.
  6. Operating Instructions: Include complete instructions with each flow meter.

N. Relays

1. Control relays shall be UL listed plug-in type with dust cover and LED “energized” indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
2. Time delay relays shall be UL listed solid state plug-in type with adjustable time delay. Delay shall be adjustable  $\pm 200\%$  (minimum) from setpoint shown on plans. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.

O. Current Switches

1. Current-operated switches shall be self-powered, solid state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

P. Pressure Transducers

1. Transducer shall have linear output signal. Zero and span shall be field adjustable.
2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.
3. Water pressure transducer shall be completed with 0-5VDC, 0-10VDC and 2 wire 4-20mA outputs.
  - a. Operating temperature: -40°F to 185°F.
  - b. Accuracy:  $\pm 0.25\%$
  - c. Sensor shall be SENVA PG Series.

4. Water differential pressure transducer shall be completed with 0-5VDC, 0-10VDC and 2 wire 4-20mA outputs.
  - a. Operating temperature media: -40°F to 248°F.
  - b. Accuracy:  $\pm 0.25\%$  BFSL
  - c. Zero-adjustment push button.
  - d. 316L stainless steel sensor construction
  - e. Sensor shall be SENVA PW Series.
- Q. Differential Pressure Type Switches (Air or Water Service)
  1. Shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application or as shown.
- R. Wireless Communication Sensors - Refer to Wireless Communications specifications

### **PART 3 - EXECUTION**

#### **3.1 SECTION INCLUDES**

- A. Examination
- B. Protection
- C. Coordination
- D. General Workmanship
- E. Field Quality Control
- F. Communication Wiring
- G. Installation of Sensors
- H. Flow Switch In

#### **3.2 EXAMINATION**

- A. The Contract Documents shall be thoroughly examined for coordination of control devices, their installation, wiring, and commissioning. Coordinate and review mechanical equipment specifications, locations, and identify any discrepancies, conflicts, or omissions that shall be reported to the Architect/Engineer for resolution before rough-in work is started.
- B. The BAS manufacturer shall inspect the jobsite in order to verify that control equipment can be installed as required, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

### 3.3 PROTECTION

- A. The BAS installation contractor shall protect all work and material from damage by their work or personnel, and shall be liable for all damage thus caused.
- B. The BAS manufacturer shall be responsible for their work and equipment until final inspection, testing, and acceptance. The BAS installing contractor shall protect their work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

### 3.4 COORDINATION

- A. Site
  - 1. Where the mechanical work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment. If the contractor installs his/her work before coordinating with other trades, so as to cause any interference with work of other trades, the contractor shall make the necessary changes in his/her work to correct the condition without extra charge.
  - 2. Coordinate and schedule work with all other work in the same area, or with work that is dependent upon other work, to facilitate mutual progress.
- B. Submittals. Refer to the “Submittals,” section of this specification for requirements.
- C. Test and Balance
  - 1. The contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
  - 2. The contractor shall provide training in the use of these tools. This training will be planned for a duration of 4 hours.
  - 3. In addition, the contractor shall provide a qualified technician to assist in the test and balance process, until the first 10% terminal units are balanced.
  - 4. The tools used during the test and balance process shall be returned to the contractor at the completion of the testing and balancing.
- D. Coordination with Controls Specified in Other Sections or Divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:
  - 1. All communication media and equipment shall be provided as specified in the “Communication” section of this specification.
  - 2. Each supplier of a controls product is responsible for the configuration, programming, start-up, and testing of that product to meet the sequences of operation described in this section.
  - 3. The Contractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this section and those provided under other sections or divisions of this specification.

### **3.5 GENERAL WORKMANSHIP**

- A. Install equipment, piping, wiring/conduit, parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Install all equipment in readily accessible locations as defined by National Electric Code (NEC). Control panels shall be attached to structural walls or properly supported in a free-standing configuration, unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.
- D. Verify integrity of all control wiring to ensure continuity and freedom from shorts and grounds prior to commencing the startup and commissioning procedures.
- E. All control device installation and wiring shall comply with Contract Documents, acceptable industry specifications, and industry standards for performance, reliability, and compatibility. Installation and wiring shall be executed in strict adherence to local codes and standard practices referenced in Contract Documents.

### **3.6 FIELD QUALITY CONTROL**

- A. All work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Contract Documents.
- B. BAS manufacturer shall continually monitor the field installation for building code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.
- C. BAS installing Contractor(s) shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

### **3.7 COMMUNICATION WIRING**

- A. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.
- B. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.
- C. Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer shall not be exceeded during installation.
- D. Contractor shall verify the integrity of the entire network following cable installation. Use appropriate test measures for each particular cable.
- E. When a cable enters or exits a building, a lightning arrestor must be installed between the line and ground.

- F. All runs of communication wiring shall be unspliced length when the length is commercially available.
- G. All communication wiring shall be labeled to indicate origin and destination.
- H. General: Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of this specification.
- I. All insulated wire to be copper conductors, UL labeled for 90°C (194°F) minimum service.

### **3.8 INSTALLATION OF SENSORS**

- A. Sensors required for mechanical equipment operation shall be factory installed and wired as specified in mechanical equipment specifications. BAS manufacturer shall be responsible for coordinating these control devices and ensuring the sequence of operations will be met. Installation and wiring shall be in accordance with the BAS manufacturer's recommendations.
- B. Sensors that require field mounting shall meet the BAS manufacturer's recommendations and be coordinated with the mechanical equipment they will be associated.
- C. Mount sensors rigidly and adequately for the environment the sensor will operate.
- D. Room temperature sensors shall be installed on concealed junction boxes properly supported by the block wall framing. For installation in dry wall ceilings, the low voltage sensor wiring can be installed exposed and must meet applicable National and Local Electrical Codes.
- E. All wires attached to wall mounted sensors shall be sealed off to prevent air from transmitting in the associated conduit and affecting the room sensor readings.
- F. Install duct static pressure tap with tube end facing directly down-stream of air flow.
- G. Install space static pressure sensor with static sensing probe applicable for space installation where applicable.
- H. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
- I. All pipe mounted temperature sensors shall be installed in matched thermowells. Install all liquid temperature sensors with heat conducting fluid in thermal wells for adequate thermal conductance.
- J. Wiring for space sensors shall be concealed in building drywall. EMT conduit is acceptable within mechanical equipment and service rooms.
- K. Install outdoor air temperature sensors on north wall complete with sun shield at manufacturer's recommended location and coordinated with Engineer.



### 3.9 ACTUATORS

- A. Mount and link multiple control damper actuators where required, per manufacturer's instructions.
- B. To compress seals when spring-return actuators are used on normally closed dampers, power the actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.
- C. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions. Coordinate any installation problems with Sheet metal Contractor.
- D. Valves - Actuators shall be mounted on valves with adapters approved by both the actuator and valve manufacturer. Actuators and adapters shall be mounted in the factory as an approved design arrangement and shall not be field modified.

### 3.10 CONTROLLERS

- A. Provide a separate DDC Controller for individual HVAC mechanical equipment. DDC Controllers shall be factory mounted, installed, and wired by mechanical equipment manufacturer as specified. BAS manufacturer shall furnish and coordinate DDC controllers and control devices and ensure that installation and wiring adhere to BAS manufacturer's design recommendations. For those mechanical equipment units that do not have factory installed controls specified, the BAS manufacturer shall field mount controls and coordinate all installation and termination information to ensure the specified sequence of operations are met.
- B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type (analog or digital) found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used in each controller.
  - 1. Future use of spare I/O point capacity shall require providing the field instrument and control device, field wiring, engineering, programming, and commissioning. No additional Controller boards or point modules shall be required to implement use of these spare points.

### 3.11 PROGRAMMING

- A. Provide sufficient internal memory for all controllers to ensure specified sequence of operations, alarming, trending, and reporting requirements are achieved. BAS manufacturer shall provide a minimum of 25% spare memory capacity for future use.
- B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.
- C. Software Programming

1. Provide programming for individual mechanical systems to achieve all aspects of the sequence of operation specified. It is the BAS manufacturer's responsibility to ensure all mechanical equipment functions and operates as specified in sequence of operations. Provide sufficient programming comments in controller application software to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.

D. The instructor(s) shall be factory-trained and experienced in teaching this technical material.

**END OF SECTION 23 09 00**

## SECTION 23 09 93 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

### 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. This Section includes control sequences for HVAC systems, subsystems, and equipment. Refer to the controls portion of this Specification and the Drawings for a complete understanding of the control sequences. Contractor shall be responsible for coordinating Division 230900 service representatives of the equipment manufacturers to implement these control sequences along with Division 26. Prior to providing submittals, all field wiring connections shall be determined and shown on the submittals for electrical and controls interface.
- B. All set-points, overrides, or ranges listed in this sequence of operation and objectives shall be adjustable through the graphic user interface (GUI) and not on the (programming) wire sheet. I.E. through the graphic interface you can manipulate timers, enable/disable, etc.
- C. Related Sections include the following:
  - 1. Section 230900 "Instrumentation and Control for HVAC" for control equipment, devices, and for submittal requirements.

#### 1.3 DEFINITIONS

- A. AI: Analog input.
- B. AO: Analog output.
- C. ASC: Application specific controllers.
- D. DDC: Direct digital control.
- E. CHW: Chilled water.
- F. CV: Control valve.
- G. DI: Digital Input.
- H. DO: Digital Output.
- I. HHW: Heating hot water.

- J. SOO: Sequence of operations.
- K. VAV: Variable air volume.

#### **1.4 OBJECTIVES**

- A. The following are objectives of the control system sequence for the facility HVAC system:
  - 1. Provide required ventilation, heating, and cooling to satisfy the loads of the facility.
  - 2. Optimize energy performance through use of Trim and Respond demand-based response logic to reset supply air temperature and supply air pressure set-points.
  - 3. Achieve stable operation under which ventilation rates and space temperature set-points are not compromised.

#### **1.5 GENERAL**

- A. Contractor shall review sequences prior to programming and suggest modifications where required to achieve the design intent. Contractor may also suggest modifications to improve performance and stability or to simplify or reorganize logic in a manner that provides equal or better performance.
- B. Include costs for minor program modifications if required to provide proper performance of the system.
- C. Unless otherwise indicated in SOO, control loops shall be enabled and disabled based on the status of the system being controlled to prevent wind-up.
- D. The term “proven” (i.e. “proven on” / “proven off”) shall mean that the equipment’s DI status point matches the state set by the equipment’s DO command point.
- E. The term “PID loop” or “control loop” is used generically for all control loops and shall not be interpreted as required proportional plus integral plus derivative gains on all loops. Unless specifically indicated otherwise, do not use the derivative term on any loops unless field tuning is not possible without it.
- F. All set-points, timers, dead-bands, PID gains, etc. listed in sequences shall be capable of being adjusted by the operator without having to access programming whether indicated as adjustable in sequences or not. Software (virtual) points shall be used for these set-points. Fixed scalar numbers shall not be imbedded in programs unless the value will never need to be adjusted.
- G. Values for all points, including real (hardware) points used in control sequences shall be capable of being overridden by the user (e.g. for testing and commissioning). If hardware design prevents this for hardware points, they shall be equated to a software point and the software point shall be used in all sequences.
- H. Where zone data (such as damper or valve position, control loop signal) is used for reset of the AHU system serving the zone, the zone tag (name) shall be recorded when it is the zone driving the reset (such as the zone requiring the most cooling). This data shall be available for reports so

that the zones that are undersized or otherwise driving the system can be identified for remediation if required.

I. VFD minimum set-points

1. Minimum speed set-points for all VFD-driven equipment shall be the greater of either 6 Hz or the minimum speed required to avoid stalling the device served.
2. Minimum speed for each piece of equipment shall be stored in a single software point that shall be used in programming (such as PID loop output range) and its value shall be assigned to the minimum speed set-point stored in the VFD via the drive network interface. In this way there is only one minimum set-point, rather than set-points both in the drive and in the software which could differ.

J. Trim & Respond Set-Point Reset Logic

1. Trim & Respond set-point reset logic and zone/system reset requests where referenced in sequences shall be implemented as described below.
2. "Requests" as pressure, cooling, or heating set-point requests generated by zones or air handling systems.

a. For each zone or system, and for each set-point reset request type listed for the zone/system, provide the following software points:

- 1) Importance Multiplier (default = 1). This point is used to scale the number of requests the zone/system is generating. A value of zero causes the zone/system's request to be ignored. A value of greater than zero can be used to effectively increase the number of requests from the zone/system based on the critical nature of the spaces served, or to increase the requests beyond the number of ignored requests (defined below) in the Trim & Respond reset block.
- 2) See zone and air handling system control sequences for logic to generate requests.
- 3) Multiply the number of requests determined from zone/system logic times the Importance Multiplier and send the system that serves the zone/system. See system logic to see how requests are used in Trim & Respond logic.

b. Variables. All variables below shall be adjustable from a reset graphic accessible from a hyperlink on the associated system/plant graphic. Initial values are defined in system/plant sequences below. Values for trim, respond, time step, etc. shall be tuned to provide stable control.

Variable	Definition
SP0	Initial set-point
SPmin	Minimum set-point
SPmax	Maximum set-point
Td	Delay timer
T	Time step
I	Number of ignored requests
R	Number of requests from zones/systems
SPtrim	Trim amount

SPres	Respond amount
SPres-max	Maximum response per time interval

- c. Trim & Respond logic shall reset set-point within the range SPmin to SPmax. When the associated device (e.g. fan, pump) is off, then set-point shall be SP0. The reset logic shall be active while the associated device is proven on, starting Td after the initial device start command. When active, every time step T, trim the set-point by SPtrim. If there are more than I requests, respond by changing the set-point by SPres times (R – I), i.e. (the number of Requests minus the number of Ignored requests), but the net response shall be no more than SPres-max. The sign of SPtrim must be the opposite of SPres and SPres-max. For example, if SPtrim = -0.1, SPres = +0.15, SPres-max = +0.35, R = 3, I = 2, then each time step, the set-point change = -0.1 + (3-2)\*0.15 = +0.05. If R = 10, then set-point change = -0.1 + (10-2)\*0.15 = 1.1, but limited to a maximum of 0.35. If  $R \leq 2$ , the set-point change is -0.1.
- d. When the flow, temperature or pressure sensor responsible for sending request for a zone is taken out for service, the request values shall be set to 0, and the GUI shall show this sensor as “out of service”.

#### K. Zones

- 1. This section applies to all single zone systems and sub-zones of air handling systems, such as terminal units, etc.
- 2. Set-points
  - a. Each zone shall have separate unoccupied and occupied set-points, and separate heating and cooling set-points.
  - b. The controls contractor shall coordinate with LBCC facilities staff to setup initial heating and cooling temperature set-points for each thermal zone.
- 3. Control Loops
  - a. Two separate control loops shall operate to maintain space temperature at set-point, the Cooling Loop and the Heating Loop. Both loops shall be continuously active.
  - b. The Cooling Loop shall maintain the space temperature at the active cooling set-point. The output of the loop shall be a virtual point ranging from 0% (no cooling) to 100% (full cooling).
  - c. The Heating Loop shall maintain the space temperature at the active heating set-point. The output of the loop shall be a virtual point ranging from 0% (no heating) to 100% (full heating).
  - d. Loops shall use proportional + integral logic or fuzzy logic. Proportional-only control is not acceptable, although the integral gain shall be small relative to the proportional gain. P and I gains shall be adjustable from the campus network.
  - e. See other sections for how the outputs from these loops are used.
- 4. Zone Modes
  - a. Heating Mode: when the output of the space heating control loop is greater than zero.

- b. Cooling Mode: when the output from the space cooling control loop is greater than zero and the output of the heating loop is equal to zero.
  - c. Dead-band Mode: when not in either Heating or Cooling Mode.
5. Alarms
- a. Zone Temperature Alarms: when a zone temperature deviates from set-point by an adjustable amount for an adjustable period of time, then trigger a zone temperature alarm.
- L. If there is communication fault from network occupancy sensor, unoccupied ventilation set-back function shall default to “occupied”.
- M. The DDC contractor shall provide a summary table with the following information on the graphical user interface:
- 1. Terminal Unit ID (AHU ID for single-zone systems)
  - 2. Room Served
  - 3. Room Temperature Actual
  - 4. Room Temperature Heating Set-Point
  - 5. Room Temperature Cooling Set-Point
  - 6. Room CO2 (where CO2 sensors are applicable)
  - 7. Occupied / Unoccupied Status
  - 8. Terminal Unit Damper Position (not applicable for single-zone systems)
  - 9. Airflow Actual
  - 10. Airflow Set-Point
  - 11. Control Valve Position
  - 12. Supply Air Temperature
- N. Information Provided by (or in Conjunction with) the Testing, Adjusting, and Balancing Contractor
- 1. Single-Zone Air-Handler Information
    - a. Fan Speed Set Points
      - 1) MinSpeed. The speed that provides supply airflow equal to DesOA with the economizer outdoor air damper fully open.
      - 2) MaxHeatSpeed. The speed that provides supply airflow equal to the design heating airflow scheduled on plans.
      - 3) MaxCoolSpeed. The speed that provides supply airflow equal to the design cooling airflow scheduled on plans.
    - b. Relief-Damper Positions
      - 1) MinRelief. The relief-damper position that maintains a building pressure of 0.05 in. of water while the system is at MinPosMin (i.e., the economizer damper is positioned to provide MinOA while the supply fan is at minimum speed).

- 2) MaxRelief. The relief-damper position that maintains a building pressure of 0.05 in. of water while the economizer damper is fully open and the fan speed is at cooling maximum.
- c. Return-Fan Speed Differential S-R-DIFF. The speed differential between supply air and return air fans required to maintain building pressure at desired pressure (0.05 in. of water) using a handheld sensor if a permanent sensor is not provided. All exhaust fans that normally operate with the air handler should be on.

## 1.6 SEQUENCE OF OPERATIONS

- A. The facility HVAC system shall be available 24 hours per day, 7 days per week. The facility shall be scheduled for operation per a programmable schedule based on day of week, hour of day, special events, holidays, etc. The user shall designate equipment as “Down” via the graphical user interface on a single page labeled as “Equipment”. All sequences listed in this document will take into account equipment that is designated as “Down” and will not call for the equipment to run until it is released by the user. In the event that a piece of equipment which is designated as down is critical to lab system mode of operation the system will alarm the user via the graphical user interface.
- B. Multiple-Zone VAV Air Handling Unit – AHU-1
  - 1. Supply Fan Control
    - a. Supply Fan Start/Stop:
      - 1) Unit operates 24/7 by default. The user shall have the ability to create a custom operational schedule. Multiple supply fans shall run in parallel at the same speed and be controlled from a single speed signal.
      - 2) When any supply air fan within the AHU is commanded on, enable the supply air pressure trim and respond loop.
      - 3) Totalize current airflow rate from VAV boxes to a software point Vps.
    - b. When the AHU supply fan is commanded on, enable the supply air pressure trim and respond loop.
    - c. Supply air fan on command enables the supply air pressure trim and respond loop.
    - d. Static Pressure Set-Point Reset
      - 1) Static pressure set-point: Set-point shall be reset using Trim & Respond logic (see Paragraph 1.5.J.) with the following parameters:

Variable	Value
SP0	1.0 in. w.c.
SPmin	0.25 in. w.c.
SPmax	1.8 in. w.c.
Td	10 minutes
T	1 minute
I	0
R	Zone Static Pressure Reset Requests
SPtrim	-0.030 in. w.c.



SPres	+0.050 in. w.c.
SPres-max	+0.150 in. w.c.

e. Static Pressure Control

- 1) Supply fan speed is controlled to maintain duct static pressure at set-point when the fan is commanded on.
- 2) Loop output shall be mapped to the VFD speed from 10% minimum VFD speed to 100% speed.
- 3) Loop output and VFD motor speed mapping achieved by physical testing and commissioning shall be recorded on GUI and in as-builts.

2. Supply Air Temperature Control

a. Control loop is enabled when the supply air fan is proven on, and disabled and output set to zero otherwise. When loop is disabled, slowly reduce loop output to zero to prevent sudden pressure changes in the hydronic distribution system.

- 1) Exception: when outside air temperature is  $\leq 36^{\circ}\text{F}$ , then enable Freeze Protection Mode by opening the chilled water control valve 10% (adjustable) to circulate water through the chilled water coil to prevent water in the chilled water coil and pipes from freezing. When the outside air temperature is  $\geq 40^{\circ}\text{F}$ , then disable Freeze Protection Mode by returning the chilled water control valve to normal operation.

b. Supply Air Temperature Set-Point.

1) AHU pre-heat:

- a) When the AHU mixed air temperature is  $50^{\circ}\text{F}$  or below (adjustable), the AHU heating coil control valve shall modulate to maintain a supply air temperature set-point of  $55^{\circ}\text{F}$  (adjustable). The heating coil control valve shall be closed otherwise.

2) Setpoint shall be reset using Trim & Respond logic (see Paragraph 1.5.J.) with the following parameters.

Variable	Value
SP0	SPmax
SPmin	$55^{\circ}\text{F}$
SPmax	$65^{\circ}\text{F}$
Td	10 minutes
T	2 minutes
I	0
R	Zone Cooling SAT Requests
SPtrim	$+0.20^{\circ}\text{F}$
SPres	$-0.25^{\circ}\text{F}$
SPres-max	$-0.80^{\circ}\text{F}$

- a) Exception: If the supply air dew-point is measured to be above 54.0°F, then the SPmax shall be limited to a maximum of 55°F dry-bulb temperature until the supply air dew-point temperature is measured to be below 52.0°F.
- 3) Supply air temperature shall be controlled to set-point using a control loop whose output is mapped to sequence the heating coil, outdoor air damper, return air damper, and cooling coil as shown in the figure below.
  - a) The points of transition along the x-axis shown and described in the figure below are representative. Separate gains shall be provided for each section of the control map (heating coil, economizer, cooling coil) that is determined by the contractor to provide stable control. Alternatively, the contractor shall adjust the precise value of the x-axis thresholds shown in the figure below to provide stable control.

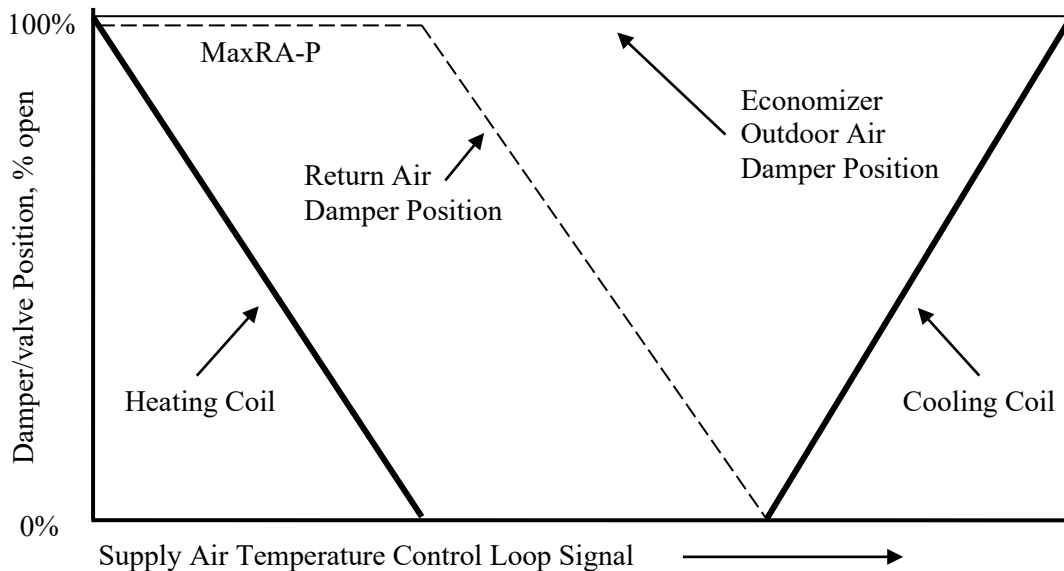


Figure 1: SAT loop mapping with return-fan control with direct building pressure controls.

- 4) Economizer Lockout: The normal sequencing of the economizer return air damper (above) shall be disabled whenever the outdoor air temperature is greater than 71°F, and enabled otherwise. Once the economizer is disabled, it shall not be re-enabled within 10 minutes, and vice versa. When the economizer is enabled, then the return air damper position shall be as mapped in the diagram above. When the economizer is disabled, then the return air damper shall be fully open.
3. Minimum Outdoor Air Control
    - a. AHU-1 has two design outside airflow (OA) values: DCV OA and Design OA. DCV OA is based upon the lowest ventilation requirement permitted by California

Title 24 when there are no occupants. Design OA correlates with California Title 24 ventilation requirements when spaces are at their design occupancy.

1) The DCV OA settings shall be balanced to the following:

a) AHU-1: 1,245 CFM

2) Design OA settings shall be balanced to the following:

a) AHU-1: 3,055 CFM

b. The return air damper position shall be modulated to achieve the minimum outside airflow setpoint as measured by the outdoor airflow monitoring station.

#### 4. Alarms

a. AHU Fan alarm is indicated by the status input being different from the output command after a period of 15 seconds after a change in output status. Alarm shall indicate which supply fan has failed including the corresponding AHU.

b. Filter pressure drop exceeds limit alarm:

c.  $DP_x = DP_{100}(x)^{1.4}$

d. Where  $DP_{100}$  is the high limit pressure drop at design CFM (determine limit from filter manufacturer) and  $DP_x$  is the high limit at airflow rate  $x$  expressed as a fraction of design airflow rate. For instance, the set-point at 50% of the design fan airflow rate would be  $(0.5)^{1.4}$  or 38% of the design high limit pressure drop.

e. High supply air temperature (more than 5°F above set-point) off cooling coils when the chilled water coil control loop is active for longer than 15 minutes.

f. While the chilled water control valve is closed, if the temperature drop across the cooling coil exceeds 2°F continuously for 30 minutes; or if the discharge temperature is more than 5°F below set-point for more than 30 minutes continuously, then trigger an alarm indicating a potentially leaking chilled water control valve.

g. Low static pressure (more than 0.25 in. w.c. below set-point) when fan control loop is active for longer than 5 minutes.

#### C. Return Fan and Relief/Exhaust Damper Control

1. The return fans shall only be enabled when the supply fans are enabled.

2. The return fans shall be controlled to maintain the return fan discharge (return plenum) static pressure set-point as described below.

3. Relief/exhaust dampers shall only be enabled when the associated supply and return fans are proven on and the minimum outdoor air damper is open. The relief/exhaust dampers shall be closed when disabled.

4. Building static pressure shall be time averaged with a sliding 5-minute window (to dampen fluctuations). The averaged value shall be that displayed and used for control.

a. Due to the potential for interaction between the building pressurization and return-fan control loops, extra care must be taken in selecting the control loop gains. To prevent excessive control-loop interaction, the closed-loop response time of the building pressurization loop should not exceed 1/5 the closed-loop response time

of the return-fan control loop. This can be accomplished by decreasing the gain of the building pressurization control loop.

5. When relief/exhaust dampers are enabled, a control loop shall modulate relief/exhaust dampers in sequence with the return-fan static pressure set point, as shown in the figure below, to maintain the building pressure at a set point of 0.05 in. of water.
  - 1) The return fan discharge minimum static pressure set-point shall be determined in collaboration with the balancing contractor to achieve building pressure of no greater than 0.05" w.c. under peak supply airflow and DCV minimum outside air conditions.
  - 2) The return fan discharge maximum static pressure set-point shall be determined in collaboration with the balancing contractor to achieve building pressure of no greater than 0.05" w.c. under peak supply airflow and full outside air economizer conditions.
  - b. From 0% to 50%, the building pressure control loop shall modulate the exhaust dampers from 0% to 100% open.
  - c. From 51% to 100%, the building pressure control loop shall reset the return-fan discharge static pressure set point from RFDSPmin at 50% loop output to RFDSPmax at 100% of loop output.

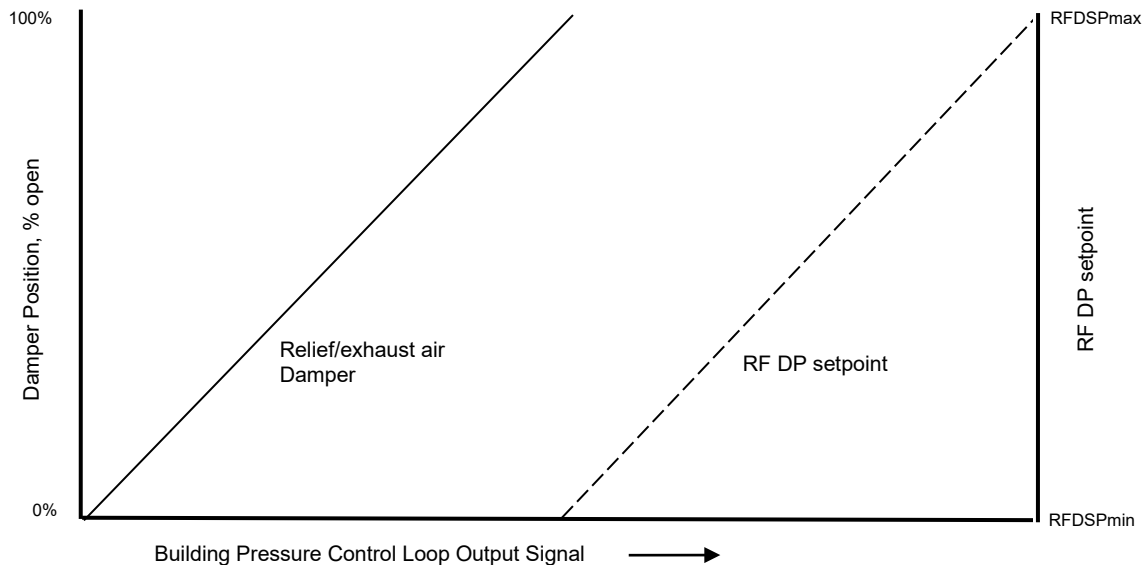


Figure 2: Relief/exhaust damper position and return-fan DP reset

6. Alarms
  - a. Return fan status alarm for no proof of fan.
    - 1) Delay Time: 5 minutes.

- b. Low discharge air static alarm if the static is 0.25" w.c. below set-point.
  - 1) Delay Time: 10 minutes.
  - 2) High discharge air static alarm if the static is 0.25" w.c. above set-point.
  - 3) Delay Time: 10 minutes.
  - 4) Low building pressure alarm if the average value is below zero in. w.c.
  - 5) Delay Time: 10 minutes.
  - 6) High building pressure alarm if the average value is above 0.07" w.c.
  - 7) Delay Time: 10 minutes.

D. Single-Zone VAV Air-Handling Unit (AHU-2 thru AHU-7)

1. See section 1.5.K Zones for set-points, loops, control modes, alarms, etc.
2. Temperature set-points (adjustable):
  - a. Cool\_SAT: 55°F
  - b. Heat\_SAT: 90°F
  - c. MaxDPT: 62°F
3. See Section 1.5.N for MinSpeed, MaxHeatSpeed, MaxCoolSpeed, MinRelief, MaxRelief, and S-R-DIFF.
4. Supply Fan Speed Control and Supply Air Temperature Set-Point Reset

Informative notes:

- These sequences use two supply air temperature set points SATsp and SATsp-C that are reset at different rates but are controlled using the same sensor and control loop, as well as a supply-fan speed reset that varies depending on outdoor air temperature. The goal of this scheme is to maximize free cooling and avoid chiller use when the outdoor air is cool, while avoiding excessive fan energy use and using the cooling coil when outdoor air is warm.
  - For this to work, it is essential that both SATsp and SATsp-C are controlled off the same physical SAT sensor.
  - It is also critical that the minimum value of the set point that controls the economizer SATsp is lower than the minimum value of the set point that controls the CHW valve SATsp-C. Otherwise, a brief temperature excursion due to the cooling coil will lead to short cycling of the economizer and subsequent unnecessary energy use by the cooling coil.
- a. The supply fan shall run whenever the unit is in any mode other than unoccupied mode.
  - b. Provide a ramp function to prevent changes in fan speed of more than 10% per minute.
  - c. Minimum, medium, and maximum fan speeds shall be as follows:
    - 1) Minimum speed MinSpeed, maximum cooling speed MaxCoolSpeed, and maximum heating speed MaxHeatSpeed shall be determined per Section 1.5.N.

- 2) Medium fan speed MedSpeed shall be reset linearly based on outdoor air temperature from MinSpeed when outdoor air temperature is greater or equal to Endpoint #1 to MaxCoolSpeed when outdoor air temperature is less than or equal to Endpoint #2.
- a) Endpoint #1: the lesser of zone temperature +1°F and maximum supply air dew point MaxDPT.
  - b) Endpoint #2: the lesser of zone temperature minus 10°F and the maximum supply air dew point MaxDPT minus 2°F.

Informative note:

- When outdoor air temperature is high, there is a potential for a high humidity ratio, and thus high space humidity, which can increase the risk of mold/mildew. When supply air dew point temperature is above the maximum limit MaxDPT, the medium speed set point is kept at the minimum, which will reduce supply air temperature and thus lower supply air temperature set point.

- d. Minimum and maximum supply air temperature set points shall be as follows:
- 1) The Deadband values of SATsp and SATsp-C shall be the average of the zone heating set point and the zone cooling set point but shall be no lower than 70°F and no higher than 75°F.
- e. When the supply fan is proven on, fan speed and supply air temperature set points are controlled as shown in Figures 3 through 5 below. The points of transition along the x-axis shown and described are representative. Separate gains shall be provided for each section of the control map, that are determined by the contractor to provide stable control. Alternatively, the contractor shall adjust the precise value of the x-axis thresholds shown in Figure 3 to provide stable control.

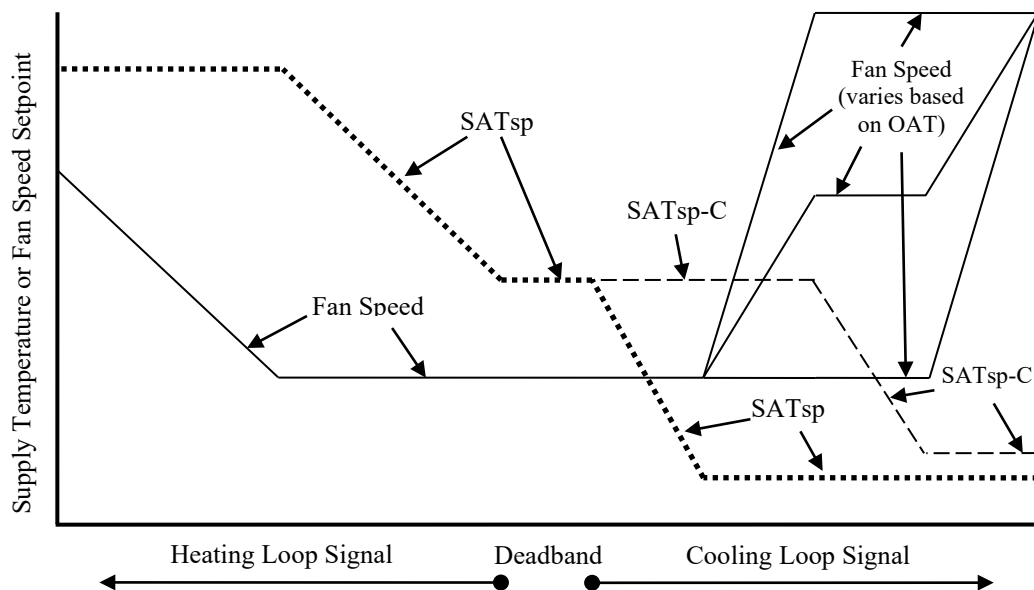


Figure 3: Control diagram for SZVAV AHU.

- f. Figures 4 and 5 separate Figure 3 in two for clarity and to illustrate the relative set points. However, both fan speed and supply air temperature set points are reset simultaneously and by the same signal: the value of the heating loop or cooling loop.
- 1) For a heating-loop signal of 100% to 50%, fan speed is reset from MaxHeatSpeed to MinSpeed.
  - 2) For a heating-loop signal of 50% to 0%, fan speed set point is MinSpeed.
  - 3) In deadband, fan speed set point is MinSpeed.
  - 4) For a cooling-loop signal of 0% to 25%, fan speed is MinSpeed.
  - 5) For a cooling-loop signal of 25% to 50%, fan speed is reset from MinSpeed to MedSpeed.
  - 6) For a cooling-loop signal of 50% to 75%, fan speed is MedSpeed.
  - 7) For a cooling-loop signal of 75% to 100%, fan speed is reset from MedSpeed to MaxCoolSpeed.
  - 8) For a heating-loop signal of 100% to 50%, SATsp is Heat\_SAT.
  - 9) For a heating-loop signal of 50% to 0%, SATsp is reset from Heat\_SAT to the deadband value.
  - 10) In deadband, SATsp is the deadband value.
  - 11) For a cooling-loop signal of 0% to 25%, SATsp is reset from the deadband value to Cool\_SAT minus 2°F, while SATsp-C is the deadband value.
  - 12) For a cooling-loop signal of 25% to 50%, SATsp and SATsp-C are unchanged.
  - 13) For a cooling-loop signal of 50% to 75%, SATsp remains at Cool\_SAT minus 2°F, SATsp-C is reset from the deadband value to Cool\_SAT.
  - 14) For a cooling-loop signal of 75% to 100%, SATsp and SATsp-C are unchanged.

Informative note:

- In cooling, the economizer is controlled to a lower set point than the cooling coil (i.e., SATsp < SATsp-C) so that a low-temperature excursion does not cause the economizer to close inadvertently while cooling with mechanical cooling.

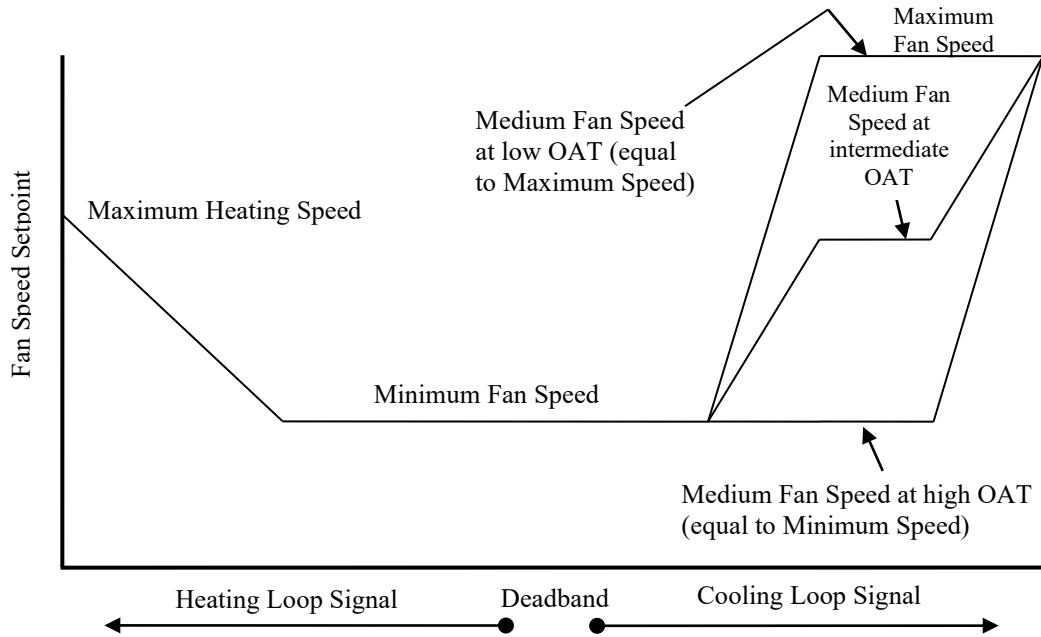


Figure 4: Control diagram for SZVAV AHU—fan speed.

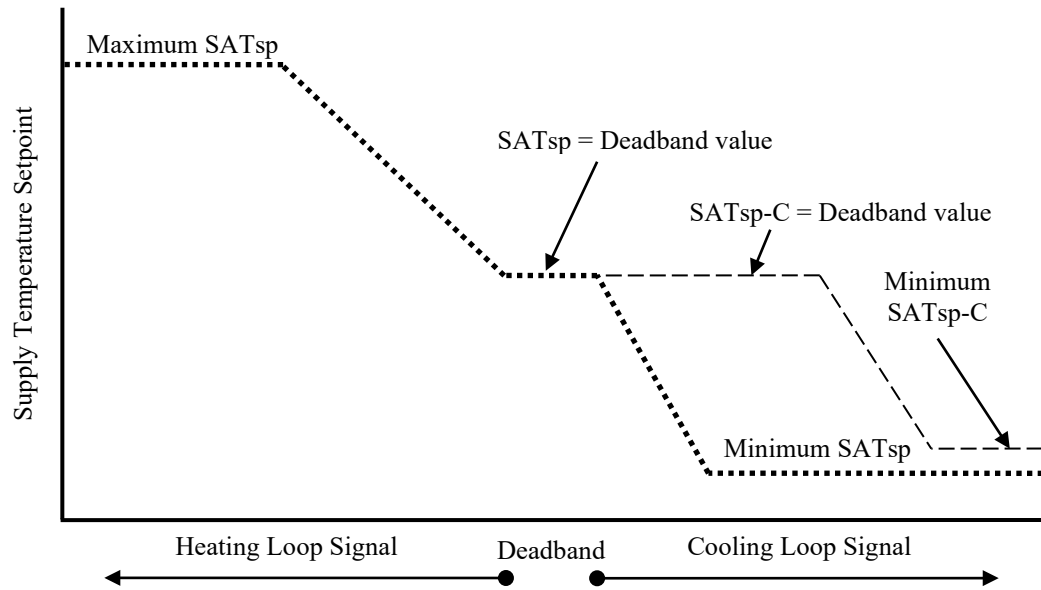


Figure 5: Control diagram for SZVAV AHU—supply air temperature.

5. Supply Air Temperature Control



- a. There are two supply air temperature set points, SATsp and SATsp-C. Each set point is maintained by a separate control loop, but both loops use the same supply air temperature sensor.
- b. The control loop for SATsp is enabled when the supply air fan is proven on and disabled and set to neutral otherwise.
  - 1) Supply air temperature shall be controlled to SATsp by a control loop whose output is mapped to sequence the heating coil and economizer dampers as shown in Figure 6. Outdoor air damper minimum MinOA-P and maximum MaxOA-P positions are limited for economizer lockout and to maintain minimum outdoor airflow rate as described in Sections 6 and 7 below.
  - 2) The points of transition along the x-axis shown in Figure 6 are representative. Separate gains shall be provided for each section of the control map (heating coil, economizer) that are determined by the contractor to provide stable control. Alternatively, the contractor shall adjust the precise value of the x-axis thresholds shown in Figure 6 to provide stable control.

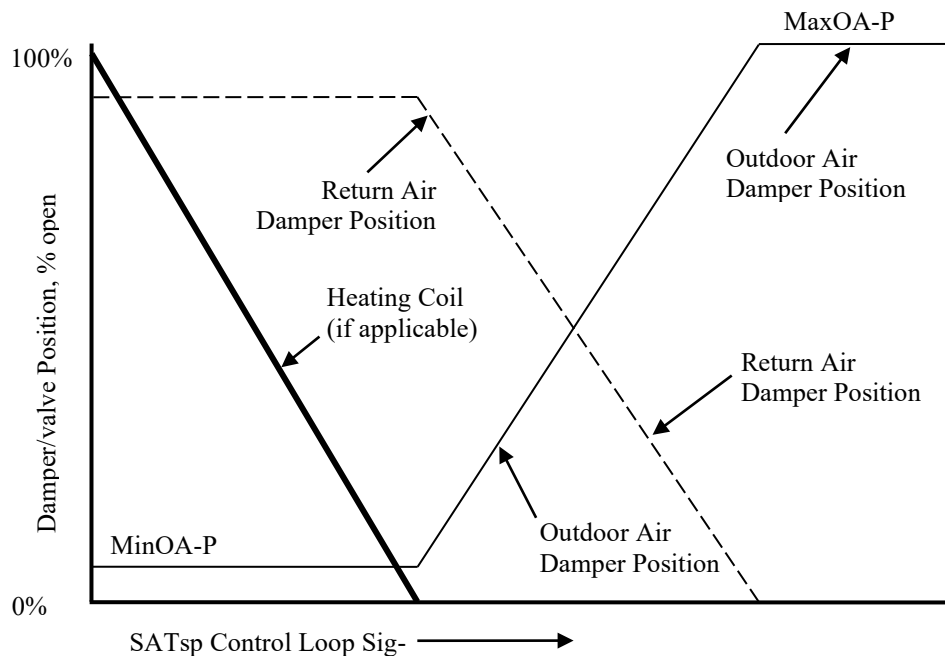


Figure 6: SZVAV AHU supply air temperature loop mapping.

- c. The control loop for SATsp-C is enabled when the supply fan is proven on and the zone state is cooling and disabled and set to neutral otherwise. When enabled, supply air temperature shall be controlled to SATsp-C by modulating the cooling coil.
6. Minimum Outdoor Air Control
    - a. Outdoor Air Damper Control

- 1) Minimum outdoor air control loop is enabled when the supply fan is proven on and in Occupied Mode and disabled and output set to zero otherwise.
  - 2) The minimum outdoor airflow rate shall be maintained at the minimum outdoor air setpoint MinOAsp by a reverse-acting control loop whose output is mapped to MinOA-P.
7. Economizer Lockout
- a. The normal sequencing of the economizer damper shall be disabled whenever the outdoor air temperature is greater than 71°F, and enabled otherwise. Once the economizer is disabled, it shall not be re-enabled within 10 minutes, and vice versa.
  - b. When economizer is enabled, MaxOA-P = 100%. When economizer is disabled, set MaxOA-P equal to MinOA-P.
8. Return-Fan Control
- a. Relief/exhaust damper shall open whenever associated supply fan is proven on.
  - b. Return fan shall run whenever associated supply fan is proven on.
  - c. Return-fan speed shall be the same as supply-fan speed with a user adjustable offset S-R-DIFF.
  - d. Relief/exhaust damper shall be closed when return fan is disabled.
- E. Typical Supply Terminal Units
1. See Paragraph 1.5.J. above for set-points, loops, control modes, alarms, etc.
  2. Design airflow rates shall be as scheduled on plans.
    - a. Zone maximum cooling airflow set-point (SAcool-max)
    - b. Zone maximum heating airflow set-point (SAheat-max)
    - c. Zone minimum airflow set-point (SAocc)
  3. Occupancy Control for Temperature Set-Point
    - a. If there is no occupancy sensor, the Occupied Cooling and Heating setpoints shall be used.
    - b. If there is an occupancy sensor,
      - 1) When the occupancy sensor is triggered, the Occupied Cooling and Heating setpoints shall be used.
      - 2) When the occupancy sensor is not triggered, the Unoccupied Cooling and Heating setpoints shall be used.
  4. CO2 Demand Control Ventilation
    - a. If the zone has a CO2 sensor, during Occupied Mode, a P-only loop shall control airflow in response to measured CO2 concentrations. The loop shall start at 0% at 600 PPM and be at 100% by 1,000 PPM of CO2. The output of this loop shall be mapped as shown in Figure 7 below. The loop output from 0 to 50% shall reset the minimum airflow set-point to the zone from SAocc-min up to the maximum

cooling airflow set-point SAcool-max. The loop output from 51% to 100% shall be used at the system level to reset the outdoor air minimum from the DCV OA minimum to the Design OA minimum. CO2 DCV loop shall be disabled and output set to zero when the zone is not in Occupied Mode.

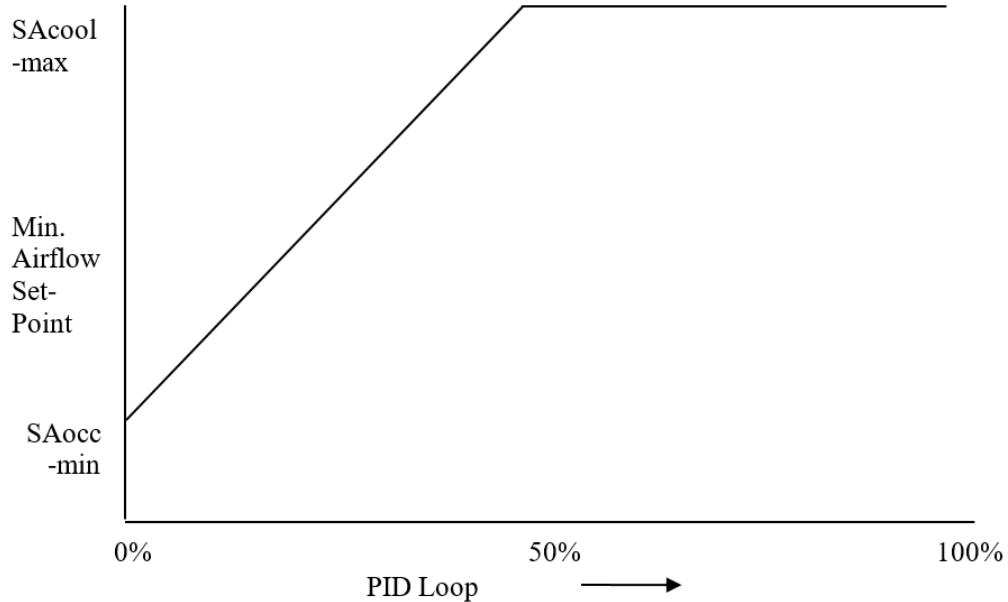


Figure 7: CO2 control

- AHU-1 control logic is depicted schematically in Figure 8 below and described in the following sections.

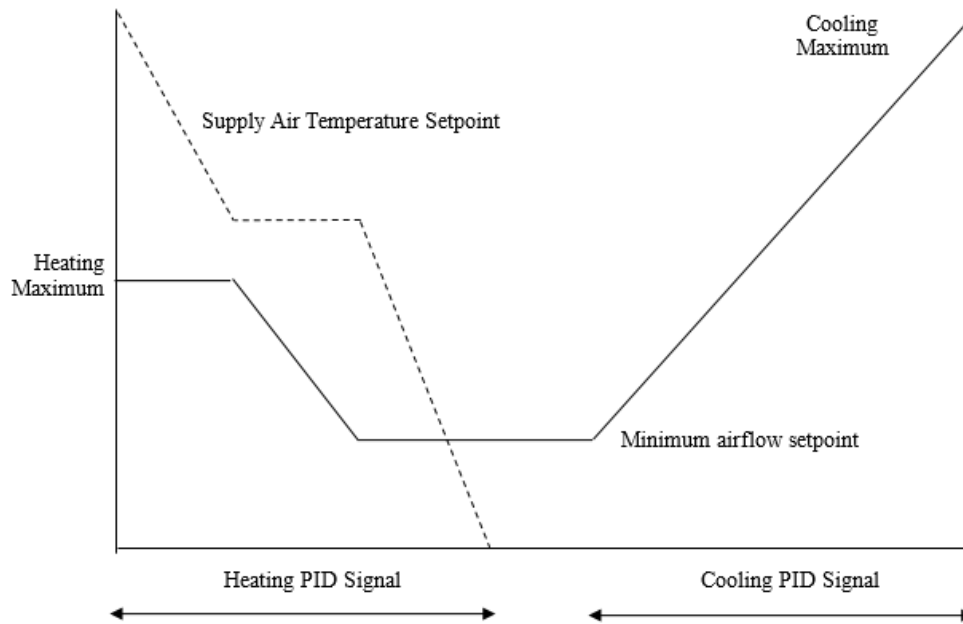


Figure 8: AHU-1 zone control logic

- a. When the zone is in the Cooling Mode, the Cooling Loop output shall be mapped to the airflow set-point from the cooling maximum to the minimum airflow set-points. Heating hot water control valve is closed unless the supply air temperature is below minimum set-point – see logic below.
  - b. When the zone is in Dead-band Mode, the airflow set-point shall be the minimum airflow set-point. Heating hot water control valve is closed unless the supply air temperature is below minimum set-point – see logic below.
  - c. When the zone is in the Heating Mode, the Heating Loop shall maintain space temperature at the heating set-point as follows.
    - 1) From 0 – 33%, the Heating Loop output shall reset the discharge temperature to [Design LAT - 10°F].
    - 2) From 34% - 66%, the Heating Loop output shall reset the zone airflow set-point from the minimum airflow set-point to the maximum heating airflow set-point.
    - 3) From 67% - 100%, the Heating Loop output shall reset the discharge temperature from [Design LAT - 10°F] to [Design LAT].
    - 4) The heating hot water control valve shall be modulated using P + I loop to maintain the discharge air temperature at set-point. Directly controlling the heating hot water control valve off zone temperature PID loop is not acceptable.
  - d. In cooling and heating mode, the heating hot water valve shall be modulated to maintain a supply air temperature no lower than 55°F. (This is to prevent overly cold supply air temperatures during cold outdoor conditions).
  - e. The VAV damper shall be modulated to maintain the measured airflow at set-point.
6. Alarms
- a. Low supply airflow: generate an alarm if airflow is the greater of either 100 CFM or 30% below set-point after a delay of 5 minutes.
  - b. High supply air temperature: generate an alarm if supply air temperature is  $\geq 10^{\circ}\text{F}$  above set-point after a delay of 3 minutes.
  - c. Low supply air temperature: generate an alarm if supply air temperature is  $\geq 10^{\circ}\text{F}$  below set-point or is below 50°F after a delay of 3 minutes.
7. System Requests
- a. Static Pressure Reset Requests
    - 1) If the Damper Loop is less than 85%, send 0 requests.
    - 2) If the Damper Loop is greater than 95%, send 1 request.
    - 3) If the measured airflow is less than 90% of set-point for 1 minute, send 2 requests.
    - 4) If the measured airflow is less than 75% of set-point for 1 minute, send 3 requests.
  - b. Cooling SAT Reset Requests

- 1) If the Cooling Loop is less than 85%, send 0 requests.
- 2) If the Cooling Loop is greater than 95%, send 1 request.
- 3) If the zone temperature exceeds the zone's cooling set-point by 3°F for 2 minutes, send 2 requests.
- 4) If the zone temperature exceeds the zone's cooling set-point by 5°F for 2 minutes, send 3 requests.

F. Restroom Exhaust Fan (EF-1)

1. EF-1 Start/Stop shall be interlocked with building schedule.

G. Multi-Speed Wall-Mounted Two-Pipe Fan Coil Units

1. Alarms:
  - a. IDF Room high temperature: an alarm shall be generated when the room temperature is 80°F or warmer after a delay of 5 minutes.
  - b. Electrical Room high temperature: an alarm shall be generated when the room temperature is 80°F or warmer after a delay of 5 minutes.

H. Laser Cutter Exhaust Fans (EF-2, EF-3)

1. The status of the laser cutters shall be available through the BAS.
2. When a laser cutter is turned on, the associated exhaust fan shall be enabled.
3. When a laser cutter is turned off, the associated exhaust fan shall run for 30 seconds (adjustable) before being disabled.

I. Dust Collector

1. A dry contact shall be provided to interlock CNC machine operation with dust collector operation.
2. The status of the dust collector shall be available through the BMS.
3. The dust collector shall shut down in the event of a fire.

**PART 2 - PRODUCTS (Not Applicable)**

**PART 3 - EXECUTION (Not Applicable)**

**END OF SECTION 23 09 93**

## SECTION 23 21 13 – 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. Copper tube and fittings.
  - 2. Steel pipe and fittings.
  - 3. Plastic pipe and fittings.
  - 4. Joining materials.
  - 5. Transition fittings.
  - 6. Dielectric fittings.
- B. Related Sections include the following:
  - 1. Section 232123 "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
  - 2. Section 230719 "HVAC Piping Insulation" for piping insulation.

#### 1.3 DEFINITIONS

- A. PTFE: Polytetrafluoroethylene.

#### 1.4 ACTION SUBMITTALS

- A. Submittals shall be formatted per Section 230000 "General Mechanical Requirements".
- B. Product Data: For each type of the following:
  - 1. Piping, tubing and fittings data. Submit data indicating that pipe, tube and fittings are manufactured exclusively in the United States.
  - 2. Fittings.
  - 3. Joining materials.
  - 4. Welding procedures.
  - 5. Coating data. Include product information and coating procedures.
- C. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the

same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

## **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Field quality-control reports.

## **1.6 QUALITY ASSURANCE**

- A. Installer Qualifications:
  - 1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Pipe Welding: Qualify procedures and operators according to 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.

## **1.7 COORDINATION**

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations or coring of foundation wall penetrations.
- C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations.
- D. Coordinate pipe fitting pressure classes with products specified in related Sections.
- E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base.
- F. Coordinate installation of pipe sleeves or coring of existing walls for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 07 Section "Penetration Firestopping" for fire and smoke wall and floor assemblies.

## **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 80 deg F.
  3. Condenser-Water Piping: 100 psig at 150 deg F.
  4. Makeup-Water Piping: 150 psig at 150 deg F
  5. Blowdown-Drain Piping: 200 deg F.
  6. Air-Vent Piping: 200 deg F.
  7. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

### **2.2 COPPER TUBE AND FITTINGS**

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L, ASTM B 88 Type K.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. Copper or Bronze Pressure-Seal Fittings:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Viega, LLC.
    - b. NIBCO, INC.
  2. Housing: Copper.
  3. O-Rings and Pipe Stops: EPDM.
  4. Tools: Manufacturer's special tools.
  5. Minimum 200-psig working-pressure rating at 250 deg F
- D. Wrought-Copper Fittings: ASME B16.22.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Anvil International, Inc.
    - b. S. P. Fittings; a division of Star Pipe Products.



### **2.3 STEEL PIPE AND FITTINGS**

- A. Piping and fittings shall be manufactured exclusively in the United States.
- B. Steel Pipe, NPS  $\frac{3}{4}$  through NPS 1½: ASTM A53, Type S (seamless) Grade A, Schedule 40, black steel, plain ends.
- C. Steel Pipe, NPS 2 through NPS 10: ASTM A53, Type S (seamless) and Type ERW (welded) Grade A or B, Schedule 40, black steel, plain ends.
- D. Steel Pipe Nipples: ASTM A733 made of ASTM A53, Schedule 40, black steel; seamless.
- E. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
- F. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
- 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. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- I. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

### **2.4 PLASTIC PIPE AND FITTINGS**

- A. CPVC Plastic Pipe: ASTM F 441/F 441M, with wall thickness as indicated in "Piping Applications" Article.
  - 1. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.
- B. PVC Plastic Pipe: ASTM D 1785, with wall thickness as indicated in "Piping Applications" Article.
  - 1. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.
- C. PEX-a (Engle-method Crosslinked Polyethylene) Piping: ASTM 876 with oxygen-diffusion barrier that meets DIN 4726.

1. PEX-a Plastic Pipe Fittings: NPS 3 and smaller, ASTM F1960 cold-expansion fitting, NPS 4 or larger, SDR9 Compression type fitting consisting of double O-ring with compression sleeve tightened around the pipe and insert.

## 2.5 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
    - a. Full-Face Type: For flat-face, 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 if unexposed, 316 stainless steel if flange is exposed.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. 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.
- 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. Solvent Cements for Joining Plastic Piping
  1. CPVC Piping: ASTM F 493.
    - a. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    - b. 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).
    - c. Solvent cement and 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."

## 2.6 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. NIBCO INC
  - b. IPEX USA
  - c. Charlotte Pipe and Foundry
  - d. Wilkins; a Zurn company
2. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.

**B. Plastic-to-Metal Transition Unions:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. NIBCO INC
  - b. IPEX USA
  - c. Charlotte Pipe and Foundry
2. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

**2.7 DIELECTRIC FITTINGS**

**A. General Requirements:** Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

**B. Dielectric Unions:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Capitol Manufacturing Company.
  - b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - c. 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.

**C. Dielectric Flanges:**

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

- a. Capitol Manufacturing Company.
  - b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - c. Wilkins; a Zurn company.
2. Description:
- a. Standard: ASSE 1079.
  - b. Factory-fabricated, bolted, companion-flange assembly.
  - c. Pressure Rating: 175 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, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Central Plastics Company
    - d. Pipeline Seal and Insulator, Inc.
  2. Description:
    - a. Nonconducting materials for field assembly of companion flanges.
    - b. Pressure Rating: 150 psig
    - c. Gasket: Neoprene or phenolic.
    - d. Bolt Sleeves: Phenolic or polyethylene.
    - e. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Elster Perfection
    - b. Grinnell Mechanical Products
    - c. Matco-Norca, Inc.
    - d. Precision Plumbing Products, Inc.
    - e. Victaulic Company
  2. Description:
    - a. Standard: IAPMO PS 66.
    - b. Electroplated steel nipple, complying with ASTM F 1545.
    - c. Pressure Rating: 300 psig at 225 deg F.
    - d. End Connections: Male threaded or grooved.

- e. Lining: Inert and noncorrosive, propylene.

### **PART 3 - EXECUTION**

#### **3.1 PIPING APPLICATIONS**

- A. Hot-water heating piping, aboveground, NPS 2-1/2 and smaller, shall be the following:
  - 1. Type L drawn-temper copper tubing, with 95-5 soldered wrought-copper fittings.
  - 2. Insulated per Section 230719 HVAC Piping Insulation.
- B. Hot-water heating piping, aboveground, NPS 3 and larger, shall be the following:
  - 1. Black steel pipe, ASTM A53, Type S (seamless) or Type ERW (welded); with standard weight ASTM A234 forged steel fittings for butt-weld connection and flanged joints.
  - 2. Insulated per Section 230719 HVAC Piping Insulation.
- C. Chilled-water piping, aboveground, NPS 2 and smaller, shall be the following:
  - 1. Type L drawn-temper copper tubing, with 95-5 soldered wrought-copper fittings.
  - 2. Insulated per Section 230719 HVAC Piping Insulation.
- D. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be the following:
  - 1. Black steel pipe, ASTM A53, Type S (seamless) or Type ERW (welded); with standard weight ASTM A234 forged steel fittings for butt-weld connection and flanged joints.
  - 2. Insulated per Section 230719 HVAC Piping Insulation.
- E. Condenser-water piping, aboveground, NPS 2 and smaller, or any size inside cooling tower shall be the following:
  - 1. Schedule 80 CPVC plastic pipe and fittings and solvent-welded joints.
- F. Condenser-water piping, aboveground and in mechanical rooms or tunnels, NPS 2-1/2 and larger shall be the following:
  - 1. Black steel pipe, ASTM A53, Type S (seamless) or Type ERW (welded); with standard weight ASTM A234 forged steel fittings for butt-weld connection and flanged joints. No threaded fittings are allowed.
- G. Makeup-water piping installed aboveground shall be the following:
  - 1. Type L drawn-temper copper tubing, with 95-5 soldered wrought-copper fittings or pressure-seal joints.
- H. Makeup-Water Piping Installed Belowground and within Slabs: Type K (Type A), annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.

- I. Condensate-Drain Piping: Type L drawn-temper copper tubing, with 95-5 soldered wrought-copper fittings
- J. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- K. 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.
- L. 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 Shop 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 mechanically formed tee fittings or integrally reinforced forged branch outlet 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 the following:
  - 1. Section 230523 "General Duty Valves for HVAC"
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install shutoff valve immediately upstream of each dielectric fitting.
- T. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.
- U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

### **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.
- C. Dielectric Fittings for NPS 2-1/2 and Larger: Use dielectric flange kits.

### **3.4 HANGERS AND SUPPORTS**

- A. Comply with requirements in Section 230529 "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 230548 "Vibration and Seismic Controls for HVAC" 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. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- G. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
1. 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. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
- E. 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.
- F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Plastic 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. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
  - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- I. 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. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
- J. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
- K. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

### **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 230519 "Meters and Gages for HVAC Piping."

### 3.7 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. Inspect finish of exposed, hydronic piping, including outlets, valves, specialties, and devices, after installation is complete. Remove burrs, dirt, and debris. Repair damaged finishes including chips, scratches, and abrasions.
  - 3. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  - 4. Flush hydronic piping systems with minimum 5 ft/s velocity clean water; then remove and clean or replace strainer screens. Promptly passivate and chemically treat piping systems after flush per requirements in Section 232513 "Water Treatment for Closed-Loop Hydronic Systems."
  - 5. 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.
  - 6. 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 make-up 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.

### 3.8 CLEANING AND PROTECTION

- A. Remove all packaging, unused fasteners, and other installation materials from the project site.
- B. Provide protection as required to leave the work in undamaged condition at the time of completion.

### 3.9 PAINTING

- A. Refer to Division 09 for additional requirements.
- B. Coating system consists of surface prep, base coat of Carbomastic 15 and a top coats of Carbothane 134, or equivalent.
  1. Install:
    - a. Surface Prep - SSPC SP1-3
    - b. 1st coat – 7.0 to 10.0 mils Carbomastic 15 Aluminum Flake Epoxy Mastic
    - c. 2nd and 3rd coats - Carbothane 133 satin or 134 Gloss Aliphatic Urethane
  2. Manufactured by Carboline.
  3. Color shall be <Insert color>.
  4. All manufacturer's installation instructions, including surface preparation, application methods and equipment, mixing and thinning guidelines, application conditions, and curing schedule shall be adhered to.

**END OF SECTION 23 21 13**

## **SECTION 23 21 13.13 - UNDERGROUND 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:
  - 1. Underground pre-insulated copper pipes and fittings.
  - 2. Underground pre-insulated steel pipes and fittings.
  - 3. Underground pre-insulated plastic pipes and fittings.

#### **1.3 ACTION SUBMITTALS**

- A. Submittals shall be formatted per Section 230000 "General Mechanical Requirements".
- B. Product Data: For the following:
  - 1. All piping data. Submit data indicating that pipe, tube and fittings are manufactured exclusively in North America, Germany or Italy.
- C. Shop Drawings: For underground heating hot water hydronic piping. Signed and sealed by a professional engineer.
  - 1. Calculate requirements for expansion compensation for underground piping.
  - 2. Show expansion compensators, offsets, and loops with appropriate materials to allow piping movement in the required locations. Show anchors and guides that restrain piping movement with calculated loads.
  - 3. Show pipe sizes, locations, and elevations. Show piping in trench, conduit, and cased pipe with details showing clearances between piping, and show insulation thickness.
  - 4. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the pipe vault structure.
  - 5. Show locations of pipe anchors and alignment guides and expansion joints and loops.
  - 6. Coordinate air vent locations based on field locations and elevations identifying system high points.
- D. Shop Drawings: For underground chilled water hydronic piping.
  - 1. Show pipe sizes and locations.

2. Coordinate air vent locations based on field locations and elevations identifying system high points.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and at vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing hydronic piping.
- B. Qualification Data: For qualified Installer.
- C. Welding certificates.
- D. Material Test Reports: For piping.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Butt fusion welding joint reports.
- H. HDPE fusion welded joint kit reports.

#### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.
  1. Comply with provisions in ASME B31.9, "Building Services Piping."
  2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. For copper, steel, and HDPE piping provide components and installation capable of producing hydronic piping systems with the following minimum working-pressure ratings:
  1. Heating Hot Water Piping: 150 psig at 200 deg F.
  2. Chilled Water Piping: 150 psig at 100 deg F.
  3. Air-vent piping: match performance of connected pipe.

## **2.2 COPPER PIPES AND FITTINGS**

- A. Copper Pipe: ASTM B-88, Type K Copper tube; type, grade, and wall thickness as indicated in "Piping Application" Article.
- B. Wrought-Copper Fittings: ASME B16.22, wall thickness to match adjoining pipe.
- C. Copper or Bronze Pressure-Seal Fittings:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Viega, LLC.
    - b. NIBCO, INC.
  - 2. Housing: Copper.
  - 3. O-Rings and Pipe Stops: EPDM.
  - 4. Tools: Manufacturer's special tools.
  - 5. Minimum 200-psig working-pressure rating at 250 deg F

## **2.3 UNDERGROUND PRE-INSULATED STEEL PIPES AND FITTINGS**

- A. Description: Factory-fabricated piping with carrier pipe, insulation, and casing. All pre-insulated pipe, fittings, insulating materials, and technical support shall be provided by the pre-insulated piping system manufacturer.
- B. Manufacturers:
  - 1. Thermacor Process Inc.
  - 2. Or approved equal.
- C. Carrier Pipe: Ferro-Therm PTS, ASTM A 53 ERW Grade B, Standard Weight, Black Steel.
- D. Carrier Pipe Insulation:
  - 1. Polyurethane Foam Pipe Insulation: Rigid, cellular, spray applied to the carrier pipe.
    - a. Comply with ASTM C 591; thermal conductivity (k-value) shall not exceed 0.16 BTU x in/h x sq. ft. x deg F at 75 deg F after 180 days of aging or to EN253 with lambda value not exceeding 0.0241W/m\*K
    - b. Insulation shall have a minimum density of 2lb/ft<sup>3</sup> and shall be a minimum 90% closed cell in structure.
- E. Insulating Diffusion Barrier:
  - 1. A diffusion barrier shall be applied on the outside of the insulation before application of the outer jacket. The barrier shall prevent the diffusion of the blowing agent out of the foam to prevent the foam from aging.

- a. Said diffusion barrier shall be applied to all joint closure kits as well to ensure continuity of the barrier.
- F. Casing: HDPE having a wall thickness not less than 125 mils for pipe sizes less than or equal to 12" and shall be extruded onto the Polyurethane foam. No tape jacket allowed. A corona treated bonding layer shall be applied onto the Polyurethane foam to ensure a secure bond between the jacket and foam insulation preventing any ingress of water at the jacket / foam interface.
- G. Casing accessories shall include the following:
1. Joint Kit: Pressure-testable. Exterior jacket shall be high strength polyethylene sleeve that is electro-fusion welded and field insulated using pourable urethane foam to the thickness specified, preformed split insulation will not be acceptable.
    - a. Fusion welding shall be done using split sleeves with embedded wires or mesh that is heated with an electro-fusion welder.
    - b. Joint kit shall be pressure testable to 5psi.
    - c. Fusion welder shall have archiving capability.
    - d. A report showing the temperatures, times and pressure testing of each joint and its location shall be submitted at the end of the job.
  2. Expansion Blanket: Elastomeric foam, formed to fit over piping.
  3. End Seals: Shrink wrap the casing material to seal watertight around casing and carrier pipe. This includes each end of all factory fabricated fittings.
- H. Straight Run Joints: Shall be insulated to the same thickness as the pipe and jacketed with an electro-fusion welded split sleeve.
1. The manufacturer shall provide the fusion machine, straps, bands, pressure gauges and closure patches for the pressure testable joint cover.
    - a. 20 extra straps and pressure testing caps shall be provided to the campus as well as an extra electro fusion welder for future repairs on the system. All sleeves shall be sized for 8" diameter piping.
  2. Heat shrink materials will not be accepted for field joints or the repair of the field joints that do not pass the pressure tests
  3. All field joints shall be pressure tested to ensure air tightness at 5psi for 5 minutes while being soap tested for leaks.
  4. Joint closure kits shall occur at straight runs only. All fittings shall be pre-manufactured.
- I. Fittings: Shall be factory pre-fabricated and pre-insulated fittings with polyurethane foam and jacketed with a butt fusion welded, or an extrusion welded and mitered HDPE jacket. Carrier pipe fittings shall be butt-welded. Fittings include expansion loops, elbows, tees, reducers, and anchors. Elbows, loops, or any other direction changes shall conform to the standards set by ASME B31.1, Code for Power Piping.
- J. Expansion / Contraction Compensation: Shall be accomplished utilizing factory pre-fabricated and pre-insulated expansion elbows, Z-bends, expansion loops, and anchors specifically designed for the intended application. External expansion compensation utilizing flexible expansion pads

(minimum one inch thickness), extending on either side, both inside and outside the radius of the fittings used with all fittings having expansion in excess of ½”.

- K. Steel Welding Fittings: ASTM A 234/A 234M, seamless or welded.
  - 1. ASME B31.1; Class 125.
  - 2. 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.
- L. Leak Detection (wire and ancillary TDR device only):
  - 1. The system shall include two wires between the carrier pipe and the HDPE jacket. The piping system manufacturer shall install the wire in a manner that has the wire embedded in the foam insulation and incorporated into each piece of pre-insulated pipe and fittings. This wire is to be capable of detection through the entire run including field joints and fittings.
  - 2. The system shall be capable of alarming based upon impedance when a TDR device is hooked up to it and shall consist of two wires for detection.
  - 3. A Cablescout TV220 TDR device and its associated software shall be provided to campus.

## **2.4 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS**

- A. Pipe:
  - 1. The pipe and fittings shall be made Extra High Molecular Weight (EHMW) high-density polyethylene with a standard thermoplastic material designation code of PE4710 and having a cell classification of 445474 per ASTM D3350.
  - 2. Materials used to manufacture pipe and fittings shall be listed under the Manufacturer's name in the Plastics Pipe Institute (PPI) TR-4, "PPI Listing of Hydrostatic Design Basis (HDB), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe." The Manufacturer shall supply a product with a standard grade HDB rating of 1600 psi (minimum) at 73 deg F and 800 psi (minimum) for 140 deg F. Upon request, the Manufacturer shall supply certification that the materials used to manufacture the pipe and fittings meet the above requirements.
  - 3. All materials, which come in contact with water, including lubricants, shall be evaluated, tested and certified for conformance with ANSI/NSF Standard 61.
  - 4. The dimensional and performance characteristics shall conform to the requirements of the most current version of AWWA C-901 (1/2" through 3") or C-906 (4" through 65"). Each lot of material shall be tested for melt index, density and % carbon.
  - 5. The pipe Manufacturer's Quality system shall be certified to be in accordance with ISO 9001.
  - 6. Method of Pipe Connection: Fusion-welded HDPE.
- B. Fittings:
  - 1. Shall be butt fusion-welded to adjacent pipe sections and shall be constructed to meet AWWA C901 or AWWA C906.
  - 2. Molded and fabricated fittings shall have a pressure rating equal to the pipe.



3. Fittings that are butt fusion welded in the field shall be insulated. End seals at uninsulated fittings shall be field-applied mastic moisture barriers. Factory manufactured fittings shall be pre-insulated using factory PE fitting covers welded to the jackets.
  4. The critical parameters of each fusion joint shall be recorded by an electronic data logging device and included in a report at the end of the job.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts:
1. Flanges and Mechanical Joint Adapters shall have a material designation code of PE3608 or higher. Flanged and Mechanical Joint Adapters can be made to ASTM D3261 or if machined, must meet the requirements of ASTM F2206. Flanges and MJ Adapters shall have a pressure rating equal to the pipe.
  2. Van-Stone style, metallic, convoluted or flat-plate, back-up rings and bolt materials shall have bolt holes and bolt circles conforming to AME B-16.1 Class 125. The back-up ring shall provide a long term pressure rating equal to or greater than the pressure-class of the pipe with which the flange adapter assembly will be used.

## **2.5 CASED PIPING SYSTEM**

- A. Description: Factory-fabricated piping with carrier pipe, insulation, and casing.
1. Thermanor Process Inc.
  2. Perma-Pipe Inc.
  3. Urecon/Logstor
- B. Carrier Pipe: As indicated in Part 3 – Application Schedule.
- C. Carrier Pipe Insulation:
1. Polyurethane Foam Pipe Insulation: Rigid, cellular, high-pressure injected between carrier pipe and jacket.
    - a. Comply with ASTM C 591; thermal conductivity (k-value) shall not exceed 0.16 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging or to EN253 with lambda value not exceeding 0.0241W/m\*K
    - b. Insulation shall have a minimum density of 2lb/ft<sup>3</sup> and shall be a minimum 90% closed cell in structure.
  2. A diffusion barrier shall be applied on the outside of the insulation before application of the outer jacket. The barrier shall prevent the diffusion of the blowing agent out of the foam to prevent the foam from aging. Said diffusion barrier shall be applied to all joint closure kits as well to ensure continuity of the barrier.
- D. Casing: LDPE or HDPE having a wall thickness not less than 100 mils for pipe sizes less than or equal to 12” and shall be extruded onto the Polyurethane foam. No tape jacket allowed. A corona treated bonding layer shall be applied onto the Polyurethane foam to ensure a secure bond between the jacket and foam insulation preventing any ingress of water at the jacket / foam interface. Markings: The outer casing shall be marked with the following information, repeated no less than every 20 feet with carrier pipe nominal size, SDR, temperature and pressure rating.

- E. Casing accessories shall include the following:
1. Joint Kit: Pressure-testable. Exterior jacket shall be high strength polyethylene sleeve that is electro-fusion welded and field insulated using pourable urethane foam to the thickness specified, preformed split insulation will not be acceptable.
    - a. Fusion welding shall be done using split sleeves with embedded wires or mesh that is heated with an electro-fusion welder.
    - b. Joint kit shall be pressure testable to 5psi.
    - c. Fusion welder shall have archiving capability.
    - d. A report showing the temperatures, times and pressure testing of each joint and its location shall be submitted at the end of the job.
  2. Expansion Blanket: Elastomeric foam, formed to fit over piping.
  3. End Seals: Shrink wrap the casing material to seal watertight around casing and carrier pipe. This includes each end of all factory fabricated fittings.
- F. Straight Run Joints: Shall be insulated to the same thickness as the pipe and jacketed with an electro-fusion welded split sleeve.
1. The manufacturer shall provide the fusion machine, straps, bands, pressure gauges and closure patches for the pressure testable joint cover.
    - a. 20 extra straps and pressure testing caps shall be provided to the Owner as well as an extra electro fusion welder for future repairs on the system. All sleeves shall be sized for 8" diameter piping.
  2. Heat shrink materials will not be accepted for field joints or the repair of the field joints that do not pass the pressure tests
  3. All field joints shall be pressure tested to ensure air tightness at 5 psig for 5 minutes while being soap tested for leaks.
  4. The critical parameters of each fusion joint shall be recorded by an electronic data logging device and included in a report at the end of the job. Images or recordings shall be taken of each joint closure kit, with some indication of the joint number and location being recorded. Recordings of pressure testing, completed joint, and Inspector-of-Record sign off for each joint shall be provided in a report at the end of the project.
  5. Joint closure kits shall occur at straight runs only. All fittings shall be pre-manufactured.
- G. Fittings: Shall be factory pre-fabricated and pre-insulated fittings with polyurethane foam and jacketed with a butt fusion welded, or an extrusion welded and mitered HDPE jacket.
- H. Source Quality Control: Factory test the carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.

## **2.6 DIRECT BURIED GATE VALVES**

1. Nonrising-Stem, Resilient-Seated Gate Valves:

- a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
  - 1) Standard: AWWA C509.
  - 2) Minimum Pressure Rating: 200 psig
  - 3) End Connections: Mechanical joint.
  - 4) Interior Coating: Complying with AWWA C550.
  - 5) Interior Coating: Complying with AWWA C550.

## 2.7 DIRECT BURIED GATE VALVE ACCESSORIES AND SPECIALTIES

### A. Tapping-Sleeve Assemblies:

1. Description: Sleeve and valve compatible with drilling machine.
  - a. Standard: MSS SP-60.
  - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
  - c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

### B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

### C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. See Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

### 3.2 PIPING APPLICATION

#### A. Hot-Water Heating Piping (NPS 2 and smaller):

1. Underground pre-insulated factory pre-insulated copper piping system with 2-inch insulation.

#### B. Hot-Water Heating Piping (NPS 2-1/2 and larger):

1. Underground pre-insulated factory pre-insulated steel piping system with 2-inch insulation.
- C. Chilled-Water Piping:
1. HDPE SDR 11 factory pre-insulated with 1-inch polyurethane carrier-pipe insulation.
    - a. Buried chilled water return piping shall be uninsulated HDPE SDR 11.

### **3.3 SPARE PARTS**

- A. As it is anticipated that rerouting will be required on the project the procurement of piping above and beyond the quantities required to perform the project according to the Drawings is required. The following quantities of spare parts for chilled water and heating hot water piping shall be provided (all piping sizes shall to match the system being installed):
1. (2) 10-foot straight pieces of piping.
  2. (8) 45 degree fittings.
  3. (4) 90 degree fittings.
  4. (6) Joint closure kits.

### **3.4 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such 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. Remove standing water in the bottom of trench.
- C. Do not backfill piping trench until field quality-control testing has been completed and results approved.
- D. Install piping at uniform grade of 0.2 percent. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points and elsewhere as required for system drainage. Install manual air vents at high points.
- E. In conduits, install drain valves at low points and manual air vents at high points.
- F. Install components with pressure rating equal to or greater than system operating pressure.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. See Section 230517 "Sleeves and Sleeve Seals for HVAC Piping" for sleeves and mechanical sleeve seals through exterior building walls.
- J. Secure anchors with concrete thrust blocks. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

### 3.5 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs for HDPE and copper pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- F. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.
- G. Conduit and Cased Piping Joints: Assemble sections and finish joints with pourable insulation and exterior jacket sleeve, and apply fusion welded seals (shrink-wrap seals are allowable where dictated in Chapter 2).
- H. Butt Fusion: The pipe shall be joined by the butt fusion process outlined in ASTM F2620 or PPI TR-33. All fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations. Fusion joints shall be made per qualified technicians per PPI TN-42.
- I. Butt Fusion joint recording: The critical parameters of each fusion joint shall be recorded by an electronic data logging device. All fusion joint data shall be included in a Fusion Technician's joint report.

### 3.6 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Direct Buried Underground Valves: AWWA, cast-iron, nonrising-stem, resilient-seated gate valves with valve box.
  - 2. Above ground valves in vaults or manholes shall be installed per Section 230523 General Duty Valves.

### 3.7 IDENTIFICATION

- A. Install continuous plastic underground warning tapes during back filling of trenches for underground hydronic piping. Locate tapes 6 to 8 inches below finished grade, directly over piping. See Section 312000 "Earth Moving" for warning-tape materials and devices and their installation.

### 3.8 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. Prepare hydronic piping for testing according to ASME B31.9 and as follows:
    - a. Leave joints, including welds, uninsulated and exposed for examination during test.
    - b. Fill system with water. Where there is risk of freezing, air or a safe, compatible liquid may be used.
    - c. Use vents installed at high points to release trapped air while filling system.
  - 2. Test hydronic piping as follows:
    - a. Subject hydronic piping to hydrostatic test pressure that is not less than 100 PSI for chilled water and 150 PSI for heating hot water.
    - b. After hydrostatic test pressure has been applied for 10 minutes, examine joints for leakage. Remake leaking joints using new materials and repeat hydrostatic test until no leaks exist.
  - 3. Test conduit as follows:
    - a. Seal vents and drains and subject conduit to 15 psig for four hours with no loss of pressure. Repair leaks and retest as required.
- C. Prepare test and inspection reports.

**END OF SECTION 23 21 13.13**

**P2S Inc.**  
005.2882.000

January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

## SECTION 23 21 16 - 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:
  - 1. Hydronic specialty valves.
  - 2. Air-control devices.
  - 3. Strainers.
  - 4. Connectors.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall be formatted per Section 230000 "General Mechanical Requirements". The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All **exceptions** shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
  - 1. "No Exception Taken".
  - 2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. Product Data: For each type of product:
  - 1. Include construction details and material descriptions for hydronic piping specialties.
  - 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
  - 3. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

#### 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.
- B. 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 HYDRONIC SPECIALTY VALVES**

- A. Bronze, Calibrated-Orifice, Balancing Valves:
  - 1. Manufacturers:
    - a. Bell & Gossett, A Zylem brand.
    - b. Armstrong Pumps, Inc.
    - c. TACO Comfort Solutions, Inc.
  - 2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
  - 3. Ball: Brass or stainless steel.
  - 4. Plug: Resin.
  - 5. Seat: PTFE.
  - 6. End Connections: Threaded or socket.
  - 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
  - 8. Handle Style: Lever, with memory stop to retain set position.
  - 9. CWP Rating: Minimum 125 psig.
  - 10. Maximum Operating Temperature: 250 deg F.

### **2.2 COIL PIPING PACKAGE**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. NuTech Hydronic Specialty Products..
  - 2. Flow Design Inc.
  - 3. Griswold Controls.
- B. Coil Piping Package – 1/2" to 2”:

1. Supply Side:
  - a. Manual air vent with pressure/temperature port.
    - 1) Brass body, EPDM core and O-ring, knurled handle and cap.
    - 2) Side vent with 1/8" hose barb and 1/4" NPT.
    - 3) Extended length.
    - 4) Minimum rating of 250 PSIG at 250°F.
  - b. Combination Y-strainer with integral pressure/temperature port. Isolation ball valve with extended handle shall be independent from piping package.
    - 1) Forged or cast brass body. EPDM O-ring. Plated steel handle with vinyl grip. Blow out-proof stem. Chrome plated ball with Teflon seats.
    - 2) Strainer with 20 mesh stainless steel screen with removable cap. Strainer shall be fitted with a hose end blow down valve with cap and chain.
    - 3) Minimum rating of 400 PSIG at 250°F.
2. Return Side:
  - a. Union with pressure/temperature port and manual air vent.
    - 1) Brass O-ring type union. EPDM O-ring. Knurled handle and cap. Blowout-proof stem. Side vent with 1/8" hose barb. 1/4" and 1/2" NPT. Extended length.
    - 2) Minimum Ratings 400 PSIG at 250°F.
  - b. Integral union with pressure/temperature port. Isolation ball valve with extended handle shall be independent from piping package.
    - 1) Forged or cast brass body. EPDM O-ring. Plated steel handle with vinyl grip. Blow out-proof stem. Chrome plated ball with Teflon seats.
    - 2) Minimum rating of 400 PSIG at 250°F.
  - c. No manual or automatic balancing valves required on main pipe.
3. Return Side:
  - a. Union with pressure/temperature port and manual air vent.
    - 1) Brass O-ring type union. EPDM O-ring. Knurled handle and cap. Blowout-proof stem. Side vent with 1/8" hose barb. 1/4" and 1/2" NPT. Extended length.
    - 2) Minimum Ratings 600 PSIG at 250°F.
  - b. Integral union with pressure/temperature port. Isolation high performance butterfly valve with extended handle shall be independent from piping package.
    - 1) High performance butterfly valve shall be lug type with ductile iron body, designed to be installed between all types of ANSI 125/150 flanges. Resilient

seat for bubble tight shut off. Blowout proof stem with pinned disc. Universal mounting flange conforms to ISO-5211. 2.5"-6" supplied with adjustable flow positioning plate. Sizes 8"- 12" provided with a gear operator.

- 2) Minimum rating of 175 PSIG at 250°F.

C. Flange end pressure/temperature port and manual air vent:

1. Pressure/temperature and manual air vent port.
2. Minimum rating of 175 PSIG at 250°F.

D. Automatic Balancing Valves:

1. Provide automatic balancing valves at pot feeder to maintain minimum flow.
2. Flowrate shall be factory set and shall valve shall automatically limit the rate of flow to within  $\pm 5\%$  of the specified GPM over at least 95% of the control range.
3. For 3/4" valve, the flow cartridge shall be removable from the Y-body housing without the use of special tools to provide access for cartridge change-out, inspection and cleaning without breaking the main piping.
4. Valve pressure loss shall not exceed seven feet.
5. Valve shall have 2 pressure and temperature ports.
6. The valve handle shall be fitted with a fine tuning memory stop handle to allow for adjusting the control range.
7. The differential pressure across the automatic balancing valve shall be measured for flow verification and to determine the amount of system over heading or under pumping.
8. Provide pressure and temperature test kit with the ability to read differential pressure from 0 to 75 PSIG, and temperature from -10 to 230°F.

## 2.3 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Body: Bronze body ball valve with stainless steel ball, NPS 1/2.
2. CWP Rating: 150 psig.
3. Maximum Operating Temperature: 225 deg F.

B. Automatic Air Vents:

1. Manufacturers:
  - a. Bell & Gossett No. 87.
  - b. Spirotherm Spirotap Model VTP.
2. Body: Brass or bronze.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/4 or 1/2.
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 240 deg F.

## 2.4 STRAINERS

### A. Y-Pattern Strainers up to NPS 1.5:

1. Manufacturers:
  - a. The Metraflex Company.
  - b. Keckley.
  - c. Mueller Steam Specialty.
2. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
3. End Connections: Threaded.
4. Strainer Screen: 40 mesh stainless-steel screen.
5. CWP Rating: 125 psig.

### B. Y-Pattern Strainers NPS 2 and Larger:

1. Manufacturers:
  - a. The Metraflex Company Model LPD.
  - b. Or Engineer approved equal.
2. Y-strainer shall be of low pressure drop design with the following Cv values:

a.	2" Pipe	120
b.	2.5" Pipe	160
c.	3" Pipe	236
d.	4" Pipe	460
e.	6" Pipe	952
f.	8" Pipe	1,580
g.	10" Pipe	2,424
h.	12" Pipe	3,200
3. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection. Strainer shall be suitable for horizontal and vertical mounting.
4. End Connections: Flanged ends.
5. Strainer Screen: Stainless-steel, screen perforations shall be:
  - a. For liquid service for NPS 2 – 3, perforation shall be 0.045"
  - b. For liquid service for NPS 4 – 12, perforation shall be 0.125"
6. Pressure Taps: Provide with inlet and outlet pressure plugs.
7. CWP Rating: 125 psig.

### **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 pressure control valves in the return water line of each cooling element.
- C. Install calibrated-orifice, balancing valves in the return pipe of each coil section for stacked coils.

#### **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.

#### **3.3 TERMINAL EQUIPMENT CONNECTIONS**

- A. Provide braided, stainless steel flexible pipe connection to and from reheat coil connections and fan coil connections.
- B. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- C. Install control valves in accessible locations close to connected equipment.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Section 230519 "Meters and Gages for HVAC Piping."

**END OF SECTION 23 21 16**

## SECTION 23 31 13 - METAL DUCTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealant and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.

- B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

1. Sheet metal thickness shall follow SMACNA requirements unless otherwise noted on drawings.

- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.

- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

- B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top 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, seismic restraints, and vibration isolation.

- C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.

#### **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. 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.

C. Field quality-control reports.

## **1.6 QUALITY ASSURANCE**

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

D. Exhaust system shall comply with CMC Chapter 5.

E. ASHRAE/IESNA 90.1 requires leakage testing for representative sections totaling no less than 25 percent of installed duct area for ducts designated to operate at a static-pressure class in excess of 3-inch wg . Consider building a mockup of typical portions of the system that can be tested early in the construction process. This standard, as enforced by some authorities having jurisdiction, requires duct systems with static-pressure classes in excess of 3-inch wg to be identified on Drawings.

## **PART 2 - PRODUCTS**

### **2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS**

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

1. Product conveying ductwork connected to the dust collector (DC-1) and laser cutter fume extraction exhaust fans (EF-2 and EF-3) shall comply with 2019 CMC section 506.2 and be constructed per tables 506.2(1) and 506.2(2).



- 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."
  - 1. For ducts with longest side less than 36 inches, use slip or drive slip connector Type T-1, T-3, T-5, T-6.
  - 2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
- 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 SINGLE-WALL 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. Factory- or shop-fabricated spiral lock seam duct:
    - a. No snap lock
    - b. Factory-fabricated longitudinal seam acceptable for ducts larger than standard factory sizes
  - 2. Manufacturers:
    - a. United Sheet Metal Division, United McGill
    - b. Semco Manufacturing, Inc.
    - c. Or equal
- 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).
- C. 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.
- D. 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.
  2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- E. Fittings:
  1. Same material and construction as duct in which installed
  2. For ductwork exposed to occupant view, do not use fabricated fittings at taps to terminal units and outlets. Instead use saddle tap cut into continuous spiral duct. Intent is for spiral duct to be continuous for aesthetic reasons. Saddle tap flange width shall be 0.5 inches or less.
- F. 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 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. General Applications (except as noted below): G60 Galvanized Coating.
  2. Plenum Walls and Blank-Offs Where in Contact with Cooling Coil: G90 Galvanized Coating.
  3. Exterior Applications: G90 Galvanized Coating.
  4. Finishes for Surfaces Exposed to View: Mill phosphatized and prepped for painting. Painting to be performed by General Contractor.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. 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.
- E. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
  2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
  4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
  5. Shop-Applied Coating Color: Black.
  6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
- 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.

## **2.4 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. CertainTeed Corporation; Insulation Group
    - b. Johns Manville
    - c. Knauf Insulation
    - d. Maximum Thermal Conductivity:
      - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
      - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  2. Antimicrobial Erosion-Resistant Coating: Apply to 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.
  3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - a. 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).

- b. Adhesive 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."
- B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick stainless 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.

## 2.5 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. Two-Part Tape Sealing System:**

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
  
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  
11. Sealant 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."

**C. Water-Based Joint and Seam Sealant:**

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

**D. Solvent-Based Joint and Seam Sealant:**

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
  
8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.

10. Sealant 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."
  11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
  12. Service: Indoor or outdoor.
  13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- E. 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.
  6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  7. Sealant 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."
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
  2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## **2.6 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.

## **2.7 SEISMIC-RESTRAINT DEVICES**

- 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. Hilti Corp.
  - 2. TOLCO; a brand of NIBCO Inc.
  - 3. Unistrut Corporation; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by the Office of Statewide Health Planning and Development for the State of California.
- C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- E. Hanger Rod Stiffener: Reinforcing steel angle or channel unistrut clamped to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## **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 and flat-oval 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/liner 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 as required by NFPA 90A. Comply with requirements in Section 233300 "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."

### **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 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."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 2. Outdoor, Supply-Air Ducts: Seal Class A.
  - 3. Outdoor, Exhaust Ducts: Seal Class B.
  - 4. Outdoor, Return-Air Ducts: Seal Class A.
  - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 1-Inch wg and Lower: Seal Class B.
  - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 1-Inch wg: Seal Class A.
  - 7. Unconditioned Space, Exhaust Ducts: Seal Class B.
  - 8. Unconditioned Space, Return-Air Ducts: Seal Class A.
  - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 1-Inch wg and Lower: Seal Class B.
  - 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 1-Inch wg: Seal Class A.
  - 11. Conditioned Space, Exhaust Ducts: Seal Class A.
  - 12. Conditioned Space, Return-Air Ducts: Seal Class A.

### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- 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 interval of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
  - 1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
  - 2. Brace a change of direction longer than 12 feet.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an evaluation service member of the ICC Evaluation Service.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
  - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect 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. Set anchors to manufacturer's recommended torque, using a torque wrench.
  - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

### **3.6 CONNECTIONS**

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### **3.7 PAINTING**

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

### **3.8 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Leakage Tests:
  - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
  - 2. Test the following systems:
    - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, selected by Engineer 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. Contractor shall develop and implement an IAQ Management Plan for the construction and preoccupancy phases of the building as follows:
  - 1. During construction meet or exceed the recommended control measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings Under Construction, and Edition 2007, ANSI/SMACNA 008-2008 (Chapter 3).

2. Protect stored materials on-site and installed absorptive materials from moisture damage.
  3. If permanently installed air handlers are used during construction, then filtration media with a minimum efficiency reporting value (MERV) of 8 must be used at each return air grille, as determined by ASHRAE Standard 52.2-2012 (with errata, but without addenda). Replace air filtration media immediately prior to occupancy.
- E. Duct system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

### **3.9 START UP**

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

### **3.10 DUCT SCHEDULE**

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
- B. Supply Air Ducts:
1. Ducts Connected to Terminal Units:
    - a. Pressure Class: Positive 1-inch wg.
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 8.
    - d. SMACNA Leakage Class for Round and Flat Oval: 4.
  2. Ducts Connected to Variable-Air-Volume Air-Handling Units:
    - a. Pressure Class: Positive 3-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 4.
    - d. SMACNA Leakage Class for Round and Flat Oval: 2.
  3. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 4.
    - d. SMACNA Leakage Class for Round and Flat Oval: 2.
- C. Return Ducts:
1. Ducts Connected to Terminal Units:
    - a. Pressure Class: Positive or negative 1-inch wg.
    - b. Minimum SMACNA Seal Class: B.

- c. SMACNA Leakage Class for Rectangular: 8.
  - d. SMACNA Leakage Class for Round and Flat Oval: 4.
2. Ducts Connected to Air-Handling Units:
- a. Pressure Class: Positive or negative 3-inch wg.
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 4.
  - d. SMACNA Leakage Class for Round and Flat Oval: 2.
3. Ducts Connected to Equipment Not Listed Above:
- a. Pressure Class: Positive or negative 2-inch wg.
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 4.
  - d. SMACNA Leakage Class for Round and Flat Oval: 2.
- D. Exhaust and Relief Ducts:
1. Ducts Connected to Fans Exhausting/Relieving (ASHRAE 62.1, Class 1 and 2) Air:
- a. Pressure Class: Negative 2-inch wg.
  - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
  - c. SMACNA Leakage Class for Rectangular: 4.
  - d. SMACNA Leakage Class for Round and Flat Oval: 2.
- E. Product-Conveying Ducts:
1. Ductwork connected to the dust collector (DC-1):
- a. Pressure Class: Negative 6-inch wg.
  - b. Comply with 2019 CMC Table 506.2(1).
2. Ductwork connected to laser cutter fume extraction exhaust fans (EF-2 and EF-3):
- a. Pressure Class: Negative 10-inch wg.
  - b. Comply with 2019 CMC Table 506.2(1) and 506.2(2).
- 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: Match duct material.
3. Aluminum Ducts: Aluminum.
- G. Liner:
1. Indoor Supply Air Ducts and Return Air Ducts shown with liner on drawings: 1 inch thick or 2 inch thick; refer to floor plans.

2. Outdoor, Exposed Supply Air Ducts and Return Air Ducts: Fibrous-glass, 2 inches thick.
3. Transfer Ducts: Fibrous-glass, 1 inch thick (unless otherwise indicated).
4. Terminal Unit Discharge Plenums: Fibrous-glass, 1 inch thick.
5. Air Handling Unit Return Inlets and Supply Outlets: For a distance of 20ft from unit inlet and outlet, Fibrous-glass, 1 inch thick (2" if located outdoors or if tagged otherwise on floor plans).

H. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Velocity 1000 fpm or Lower:
    - 1) Radius Type RE 1 with minimum 1.0 radius-to-width ratio.
      - a) If 1.0 radius-to-width ratio is not possible, provide single splitter vane per specification 233300 section 2.12, down to ducts with radius-to-width ratio of 0.75.
    - b. Velocity 1000 to 1500 fpm:
      - 1) Radius Type RE 1 with minimum 1.0 radius-to-width ratio.
      - 2) Radius Type RE 3 with minimum 1.0 radius-to-width ratio and single-thickness turning vanes.
        - a) If 1.0 radius-to-width ratio is not possible, provide single splitter vane per specification 233300 section 2.12, down to ducts with radius-to-width ratio of 0.75.
    - c. Velocity 1500 fpm or Higher:
      - 1) Radius Type RE 1 with minimum 1.5 radius-to-width ratio.
        - a) If 1.5 radius-to-width ratio is not possible, provide single splitter vane per specification 233300 section 2.12, down to ducts with radius-to-width ratio of 0.75.
      - 2) Radius Type RE 3 with minimum 1.5 radius-to-width ratio and single-thickness turning vanes.
  2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
    - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      - 1) Velocity 1000 fpm or Lower: 1.0 radius-to-diameter ratio and three segments for 90-degree elbow.

- 2) Velocity 1000 to 1500 fpm: 1.5 radius-to-diameter ratio and four segments for 90-degree elbow.
- 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
- 4) Radius-to Diameter Ratio: 1.5.

- b. Round Elbows, 10 Inches and Smaller in Diameter: Stamped or pleated.
- c. Round Elbows, 12 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: Conical.
2. Taps shall be the more stringent of what is shown on the mechanical drawings and the criteria listed below. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
  - a. Velocity 900 fpm or Lower: 90-degree tap.
  - b. Velocity 901 to 1500 fpm: Conical tap.
  - c. Velocity 1501 fpm or Higher: 45-degree lateral.

**END OF SECTION 23 31 13**

## **SECTION 23 33 00 - AIR DUCT ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Manual volume dampers.
  - 2. Combination fire and smoke dampers.
  - 3. Flange connectors.
  - 4. Turning vanes.
  - 5. Remote damper operators.
  - 6. Duct-mounted access doors.
  - 7. Flexible connectors.
  - 8. Flexible ducts
  - 9. Duct accessory hardware.
  - 10. Splitter vanes.
- B. Related Requirements:
  - 1. Section 284621.11 "Addressable Fire-Alarm Systems" for duct-mounted fire and smoke detectors.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
  - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
    - a. Special fittings.
    - b. Manual volume damper installations.
    - c. Combination fire- and smoke-damper, including sleeves; and duct-mounted access doors and remote damper operators.



#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- B. Source quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

### PART 2 - PRODUCTS

#### 2.1 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. 2D finish for concealed ducts and No. 4 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 MANUAL VOLUME DAMPERS**

- A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.
- B. Fabricate splitter dampers of material same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.
- C. Fabricate splitter dampers of single thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/4 inch diameter rod in self aligning, universal joint action flanged bushing with set screw.
- D. Fabricate single blade dampers for duct sizes to 12 x 48 inch.
- E. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- F. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- G. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches provide regulator at both ends.
- H. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

### **2.4 COMBINATION FIRE AND SMOKE DAMPERS**

- A. Manufacturer shall be Greenheck, Ruskin, Pottorff, or equal.
- B. Combination Smoke/Fire Dampers shall be furnished and installed at all locations shown on the plans and/or as described on the drawing details.
- C. Damper shall meet the requirements of NFPA 90A, 92A, and 92B and further shall be tested, rated and labeled in accordance with the latest edition on UL Standard 555 and 555S. Dampers shall have a UL555 fire rating of 1-1/2 hours and be of low leakage design qualified to UL 555S Leakage Class I.

- D. Damper actuator combination shall have a UL 555S elevated temperature rating of 350 degrees Fahrenheit minimum and shall be operational and dynamic rated to operate at maximum design airflow rate at its installed location.
- E. Damper shall be supplied with an appropriate actuator installed by the damper manufacturer at the time of damper fabrication. Damper actuator shall be electric type for 120 volt operation.
- F. Damper blades shall be 14 gauge galvanized steel type. Damper frame shall be galvanized steel formed into a structural hat channel shape with reinforced corners. Bearing shall be sintered bronze sleeve type rotating in extruded holes in the damper frame. Blade seals shall be silicone rubber designed to inflate and provide a tighter seal against leakage as pressure on either side of the damper increases. Jamb seals shall be stainless steel compression type with silicone rubber backing. Blades shall be completely symmetrical relative to their axle pivot point, presenting identical resistance to airflow in either direction or pressure on either side of the damper.
- G. Damper must be rated for mounting vertically (with blades running horizontally) or horizontally and be UL 555S rated for leakage and airflow in either direction through the damper.
- H. Damper shall be supplied with a 165 degree Fahrenheit fusible link. Provide access doors at either side of the combination smoke/fire damper for viewing of the fusible links.
- I. The specified combination smoke/fire damper shall meet the requirements for fire dampers, smoke dampers and combination fire smoke dampers established by:
  - 1. National Fire Protection Association NFPA Standard 90A, 92A, 92B and 101
  - 2. Underwriters Laboratories Standard 555 Listing #R-13317
  - 3. Underwriters Laboratories Standard 555S Listing #R-13447
  - 4. California State Fire Marshall CSFM Fire Damper Listing #3225-0981:103
  - 5. California State Fire Marshall CSFM Leakage Smoke Damper Listing #3230-0981:104
- J. Smoke Detector will be provided by the electrical contractor to be compatible with the fire alarm system. Mechanical contractor shall install all duct-mounted smoke detectors. Electrical contractor shall connect smoke detector to smoke dampers and fire alarm panel. After installation is complete, electrical contractor shall test and verify that smoke detectors are active and functional.

## **2.5 FLANGE CONNECTORS**

- A. Manufacturer shall be Ductmate, CL WARD, or equal.
- B. Description: Roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

## **2.6 TURNING VANES**

- A. Manufacturer shall be Ductmate, CL WARD, or equal.
- 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.
- 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.

## **2.7 REMOTE DAMPER OPERATORS**

- A. Manufacturer shall be Greenheck RBD-10 (for rectangular ductwork) and RBDR-50 (for round ductwork) or equal electrically actuated balancing damper assembly.
  - 1. Galvanized steel frame and 20 ga. galvanized steel blades.
  - 2. Supplied with 9 volt actuator.
  - 3. All wire connections to be made using RJ11 plugs and sockets, no additional wiring or tools needed.
  - 4. Suitable for pressures up to 1 in. wg, velocities up to 2,000 fpm and temperatures up to 180°F
  - 5. Accessories:
    - a. Greenheck EZ Balance remote.
    - b. Actuator kit.
    - c. Single gang wall plate accessory with single gang outlet box:
      - 1) Material: Stainless steel.
      - 2) One to six port options are available. Contractor to use maximum number of ports to minimize number of wall plates based on maximum allowable cable lengths.
      - 3) Wall plates to be located in ceiling. Contractor to align all wall plates within a room/corridor to maintain a uniform appearance.
    - d. Plenum rated cable, up to maximum 50ft length.

## **2.8 DUCT-MOUNTED ACCESS DOORS**

- A. Manufacturers shall be Ventfrabrics, Ductmate, Pottorf Company or equal.
- B. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards and as indicated.
- C. Review locations prior to fabrication.

- D. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.
- E. Access doors smaller than 12 inches square may be secured with sash locks.
- F. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.
- G. Access doors with sheet metal screw fasteners are not acceptable.

## **2.9 FLEXIBLE CONNECTORS**

- A. Manufacturer: Duro Dyne, Ventfabrics or equal.
- 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.
- G. Dust Collection and Laser Cutter Fume Exhaust Systems, Flexible Connectors: Fiberglass/satin weave fabric with Teflon coating (Duro Dyne Teflon or equal).
  - 1. Minimum Weight: 16.5 oz./sq. yd.
  - 2. Tensile Strength: 400 lbf/inch in the wrap and 300 lbf/inch in the filling.
  - 3. Service Temperature: Minus 150 to plus 500 deg F.

## **2.10 FLEXIBLE DUCTS**

- A. Manufacturers:
  - 1. Casco,

2. Thermaflex,
3. Or submitted equal approved by the Engineer of Record.

**B. Flexible Ductwork up to 22" ID:**

1. UL 181, Class I Air Duct.
2. Minimum positive static pressure class: 6 inches w.c.
3. Minimum negative pressure class: 1 inch w.c.
4. Insulated to a minimum of R-4.2.
5. Product basis of design: Casco Cal-Flex 2PMJ or submitted equal approved by the Engineer of Record.

**2.11 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.

**2.12 SPLITTER VANES**

- A. General Requirements: Comply with SMACNA's "HVAC HVAC Systems Duct Design"; Figure 5-12 and Table A-7 section G for one splitter vane.
  1. Calculate R/W ratio by dividing elbow radius by duct width.
  2. From R/W ratio, determine corresponding CR value from Table A-7 section G.
  3. Calculate R1 (splitter vane radius) by dividing R by CR value.

**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. Compliance with ASHRAE/IESNA 90.1-2004 includes Section 6.4.3.3.3 - "Shutoff Damper Controls," restricts the use of backdraft dampers, and requires control dampers for certain applications. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

- D. 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.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Remote damper operators:
  - 1. Use remote damper operators for:
    - a. Dampers located above non-removable ceilings.
    - b. Dampers concealed behind walls.
    - c. Dampers concealed within shafts.
  - 2. Remote damper operator wall/ceiling plate accessory requirements:
    - a. One to six port options are available. Contractor to use maximum number of ports to minimize number of wall/ceiling plates based on maximum allowable cable lengths.
    - b. Wall/ceiling plates to be located in ceiling. Contractor to align all wall plates within a room/corridor to maintain a uniform appearance.
- G. Install test holes at fan inlets and outlets and elsewhere as indicated.
- H. Install fire and smoke dampers according to UL listing.
- I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Upstream and downstream from duct filters.
  - 3. At outdoor-air intakes and mixed-air plenums.
  - 4. At drain pans and seals.
  - 5. Downstream from backdraft dampers.
  - 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. Control devices requiring inspection.
  - 8. Elsewhere as indicated.
- J. Install access doors with swing against duct static pressure.
- K. Access Door Sizes:
  - 1. One-Hand or Inspection Access: 8 by 5 inches
  - 2. Two-Hand Access: 12 by 6 inches
  - 3. Head and Hand Access: 18 by 10 inches

4. Head and Shoulders Access: 21 by 14 inches
  5. Body Access: 25 by 14 inches
  6. Body plus Ladder Access: 25 by 17 inches
- L. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- M. Install flexible connectors to connect ducts to equipment.
- N. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- O. Where indicated on Drawings, connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
1. All flexible ducts shall be installed per the latest version of the Air Diffusion Council (ADC) Flexible Duct Performance and Installation Standards "Green Book." Installation shall minimize air pressure drop due to sagging and compression.
  2. Restroom exhaust ductwork to be connected directly to grilles. Flexible ducts shall not be used.
- P. Connect flexible ducts to metal ducts with draw bands.
- Q. 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, smoke, and combination 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.
  5. Operate remote damper operators to verify full range of movement of operator and damper.

**END OF SECTION 23 33 00**



**P2S Inc.**  
005.2882.000

January 10, 2022  
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**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

## SECTION 23 33 19 – DUCT SILENCERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

#### 1.2 SUMMARY

- A. 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 construction documents.
  - 2. Submit Manufacturer's recommended installation instructions and procedures.
  - 3. Identify all proposed changes, differences and/or discrepancies, including verbiage, terms and definitions between Contract Documents and submittals.
  - 4. Submit a list of all field conditions which the manufacturer has determined will limit the specified acoustical performance requirements specified for duct silencers.
  - 5. Silencer manufacturer to provide a copy of their laboratory NVLAP accreditation certificate for the ASTM E-477 test standard with the submittals. Data from non-NVLAP accredited test facilities will not be accepted.
  - 6. Submit laboratory acoustic and aerodynamic performance obtained according to ASTM E477 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials. The laboratory must be NVLAP accredited for the ASTM E477 test standard. A copy of the accreditation certificate must be included with the submittals. Data from non-NVLAP accredited test facilities will not be accepted. Shop drawings submitted without proper certifications will be rejected.
    - a. Sound trap model number, dimensions and silencer designation.
    - b. The manufacturer shall supply certified dynamic insertion loss data for each scheduled silencer in octave bands centered at 63 Hz through 8,000 Hz for both forward and reverse flow conditions.

- c. The manufacturer shall supply certified self-noise power level data for each scheduled silencer in same octave bands as above.
- d. Maximum pressure drop at required air volume. Submitted silencer pressure drops shall not exceed those listed in the silencer schedule.

#### 1.4 QUALITY ASSURANCE

- A. The manufacturer shall have successful experience in duct silencer production, including no less than five years' experience in fabrication and delivery of duct silencers equal in size and quantity to this Work. The Manufacturer shall be capable of supplying references and acoustical test results for up to five recently completed projects similar to this Work.
- B. Silencer performance must have been substantiated by laboratory testing in a duct-to-reverberant room test facility according to ASTM E477 Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers or a test standard approved by the acoustical consultant. The test facility must provide for airflow in both directions through the test silencer. The test set-up, procedure and facility shall eliminate all effects due to flanking, directivity, end reflection, standing waves and reverberation room absorption. The aero-acoustic laboratory must be currently NVLAP accredited for the ASTM E477 test standard.
- C. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- D. Silencer manufacturer shall provide a written test report by a third party organization showing silencer assemblies 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.
- E. The architect or project acoustical consultant shall be the final arbiter in determining compliance.

### PART 2 - PRODUCTS

#### 2.1 DUCT SILENCERS

- A. Manufacturers: Vibro-Acoustics (Basis of Design) or Industrial Acoustics Company (IAC).
  - 1. Alternate manufacturers must request and obtain written approval by the Acoustic Consultant to bid the project at least 10 days prior to the bid due-date. As a condition of pre-approval, alternate manufacturers must submit to the Acoustic Consultant a minimum of five (5) different HVAC silencer test reports. Each report shall be for a silencer tested in full accordance with the ASTM E-477 silencer test standard in an aero-acoustic test facility which is NVLAP accredited for the ASTM E-477 standard. A copy of the laboratory's NVLAP accreditation certificate must be included with the submitted reports.
- 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. Casings shall be lock-formed 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 job site. 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, sealants, and acoustical spacers, 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.
  - a. Airstream surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
  - b. Outer casings of rectangular duct silencers shall be made of 22 gauge galvanized steel in accordance with ASHRAE and SMACNA standards for the pressure and velocity classification specified for the air distribution system in which it is installed.
  - c. Outer casings of rectangular elbow silencers shall be made of 18 gauge galvanized steel in accordance with ASHRAE and SMACNA standards for the pressure and velocity classification specified for the air distribution system in which it is installed.
7. Outer casings of circular silencers shall be made of galvanized steel as listed below.
  - a. Circular silencers: Up to 18-inches in diameter: 22 gauge.
  - b. Circular silencers: 18-inches to 30-inches in diameter: 20-gauge.
  - c. Circular silencers: 30-inches to 54-inches in diameter: 18-gauge
  - d. Circular silencers: greater than 54-inches in diameter: 16-gauge
8. Inner perforated galvanized steel liners:
  - a. Rectangular silencers: 26-gauge.
  - b. Elbow silencers: 22 gauge.
  - c. Circular silencers: Up to 18-inches in diameter: 26 gauge.
  - d. Circular silencers: Greater than 18-inches in diameter: 22-gauge.
9. Sound absorbing fill material shall be inert and vermin proof fibrous material of a density sufficient to obtain the specified acoustic performance. Fiberglass shall be packed with a minimum of 15% compression during silencer assembly. Media shall be bacteria and fungus resistant. It shall be resilient such that it will not crumble or break. It shall

conform to irregular surfaces. Media shall not cause or accelerate corrosion of aluminum or steel.

- a. Where indicated on the silencer schedule for dissipative silencers, fiberglass fill material shall be encapsulated in fiberglass cloth to help prevent shedding, erosion and impregnation of the fiberglass.
10. Where indicated on the silencer schedule for film lined silencers, the fiberglass fill material shall be completely wrapped with polymer bag enclosing fill to help prevent shedding, erosion and impregnation. The polymer bag shall be heat sealed before assembly. The enclosed acoustic media shall be separated from the perforated metal by a factory installed 1/2-inch thick acoustically transparent spacer. The spacer shall be flame retardant and erosion resistant. Silencer manufacturer shall provide a written test report by a third party organization showing silencer assemblies 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.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install silencer according to manufacturer's written installation instructions.
- B. Install where shown on Drawings in accordance with the manufacturer's recommendations to obtain the published acoustical and air flow performance.
- C. Sound trap baffles should be oriented so as to be parallel to the plane of the turn if the sound trap is located in a position less than 3 duct diameters in distance from the elbow. The duct diameter shall be based upon the maximum duct cross sectional dimension of the sound trap.
- D. If the sound trap is located greater than 3 duct diameters away from an elbow, the orientation is not critical.
- E. Do not locate rectangular sound attenuators within one duct diameter from elbows, fan suction or discharge openings, takeoffs, etc. unless indicated on the drawings.

#### 3.2 SCHEDULES

Tag	Face Dim.	Length, in	Face Velocity, FPM	Pressure Drop, In w.g.*	Dynamic Insertion Loss (dB re: 10 <sup>-12</sup> W)							
					63	125	250	500	1000	2000	4000	8000
ST-1	20x48	36			3	4	8	16	26	19	12	8

ST-2	16x30	18			2	5	8	14	17	19	12	10
Notes: * Maximum pressure drops listed above do not include losses due to system effects. ** Denotes an Elbow Silencer.												

Tag	Face Dim.	Length, in	Face Velocity, FPM	Pressure Drop, In w.g.*	Maximum Self-Noise (Sound Power Levels, dB re: 10 <sup>-12</sup> W) Based on 5-sq ft face area.							
					63	125	250	500	1000	2000	4000	8000
ST-1	20x48	36			55	52	48	49	53	51	39	30
ST-2	16x30	18			52	42	34	33	35	34	25	19
Notes: * Maximum pressure drops listed above do not include losses due to system effects. ** Denotes an Elbow Silencer.												

**END OF SECTION 23 33 19**

**Waveguide LLC**  
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**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

**SECTION 23 34 00 – EXHAUST FAN NOISE REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

**1.2 SUMMARY**

- A. The fan manufacturer shall furnish factory supplied data showing the sound power levels for each fan.

**1.3 REFERENCES**

- A. All sound power level measurements and calculations shall be made in complete accordance with the latest version of AMCA Standard 300, Test Code for Sound Rating, and AMCA Standard 301, Method for Calculating Fan Sound Ratings from Laboratory Test Data. Equivalent test and calculation procedures may be substituted for the above procedures if approved in advance by the Architect.

**1.4 SUBMITTALS**

- A. Submit octave band sound power level data at the design airflow and static pressure conditions for each scheduled exhaust fan. All acoustic data shall be measured and provided in accordance with AMCA Standard 300 or a test standard approved by the project Acoustical Consultant.

**PART 2 - PRODUCTS**

**2.1 EXHAUST FAN SOUND POWER LEVELS**

- A. The sound power levels of each fan coil unit shall not exceed the values list in the schedule below when operating at the maximum design airflow and static pressure conditions.

<b>OCTAVE BAND SOUND POWER LEVELS (Lw), (dB re: 10<sup>-12</sup> Watts)</b>								
	<b>63</b>	<b>125</b>	<b>250</b>	<b>500</b>	<b>1000</b>	<b>2000</b>	<b>4000</b>	<b>8000</b>
EF-1								
EF-2 INLET	82	92	89	82	80	77	70	68
EF-2 OUTLET	82	92	89	82	80	77	70	68
EF-3 INLET	82	92	89	82	80	77	70	68
EF-3 OUTLET	82	92	89	82	80	77	70	68



- B. In the event the sound power level specifications are exceeded by a submitted product, it shall be the option of the contractor, if approved in advance by the Architect and Mechanical Engineer, to provide additional sound traps or other sound attenuation devices (e.g. plenums, duct liner) to supplement the specified design in order to comply with the sound power level specification. The cost for the additional noise control shall be borne by the contractor. Calculations shall be provided by the contractor which substantiate that the sound power levels produced by the substituted equipment and any required sound attenuation devices do not exceed the specified sound power levels.

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

**END OF SECTION 23 34 00**

## SECTION 23 34 23 - HVAC FANS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Centrifugal roof ventilators.
  - 2. In-line centrifugal fans.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
  - 1. Certified fan performance curves with system operating conditions indicated.
  - 2. Certified fan sound-power ratings.
  - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
  - 4. Material thickness and finishes, including color charts.
  - 5. Dampers, including housings, linkages, and operators.
  - 6. Roof curbs.
  - 7. Fan speed controllers.
- 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.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For HVAC fans to include in emergency, operation, and maintenance manuals.

## **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Belts: One set(s) for each belt-driven unit.

## **1.7 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.
- C. UL Standards: HVAC fans shall comply with UL 705. HVAC fans for use for restaurant kitchen exhaust shall also comply with UL 762.

## **1.8 COORDINATION**

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- D. Provide access around equipment as specified on plans and/or according to manufacturer's requirements.

## **1.9 WARRANTY**

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents
- B. The warranty of this equipment is to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at the Manufacturers option when returned to Manufacturer, transportation prepaid.

## **PART 2 - PRODUCTS**

### **2.1 MOTORS**

- A. AC Induction Motor

1. Motor enclosures: Totally Enclosed Fan Cooled
2. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase

**B. Electronically Commutated Motor**

1. Motor enclosures: Open type
2. Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable.
3. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
4. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor
5. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
6. Motor shall be a minimum of 85% efficient at all speeds.

## **2.2 CENTRIFUGAL ROOF VENTILATORS**

**A. Manufacturers:**

1. Greenheck
2. Loren Cook
3. PennBarry
4. Twin City Fans

**B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.**

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains and grease collector (where indicated on schedule).
2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

**C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.**

**D. Direct drive, electronically-commutated motor.**

**E. Options/Accessories:**

1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
3. Dampers (where indicated on schedule): Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops, Greenheck WD-10 or equal.
4. Factory-mounted grease trap (where indicated on schedule).
5. UL 762 Rated (where indicated on schedule).

6. Finishes: Hi-Pro Polyester (where indicated on schedule) - one part coating which yields a hard, durable surface resistant to salt water, chemical fumes and moisture.
7. Roof curb, 12" height.
8. Hinged roof curb with vented curb extension (where indicated on schedule).

### **2.3 IN-LINE CENTRIFUGAL FANS**

A. Manufacturers:

1. Greenheck
2. Loren Cook
3. PennBarry
4. Twin City Fans

B. Housing: Square design constructed of heavy gauge galvanized steel. Housing and bearing supports constructed of heavy gauge bolted and welded steel construction to prevent vibration and to rigidly support the shaft and bearing assembly.

C. Shafts and Bearings:

1. Fan shaft shall be ground and polished solid steel with an anti-corrosive coating.
2. Permanently sealed bearings or pillow block ball bearings.
3. Bearing shall be selected for a minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
4. Fan Shaft first critical speed is at least 25 percent over maximum operating speed.

D. Fan Wheels: Aluminum, non-overloading, backward inclined centrifugal wheel. Single thickness blades are securely riveted or welded to a heavy gauge back plate and wheel cone.

E. Accessories:

1. Companion Flanges: For inlet and outlet duct connections.

### **2.4 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.

1. Sound power of submitted equipment shall be acoustically equivalent to the sound power of the basis of design equipment.

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. Install HVAC fans level and plumb.
- B. Equipment Mounting:
  - 1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Control for HVAC."
- C. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.
- D. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548 "Vibration and Seismic Control for HVAC."
- E. Install units with clearances for service and maintenance of fans, motors and all other components that may need access
- F. Label units according to requirements specified in Section 230553 "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 233300 "Air Duct Accessories."
- B. Install ducts adjacent to HVAC fans to allow service and maintenance.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### **3.3 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. 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 230593 "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 23 34 23**

## SECTION 23 36 00 - AIR TERMINAL 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. Single-duct air terminal units.
  - 2. Casing liner.

#### 1.3 ACTION SUBMITTALS

- A. Submittals shall be formatted per Section 230000 "General Mechanical Requirements". The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section. All **exceptions** shall be clearly identified by referencing respective paragraph and other requirements. Next to each specification item, indicate the following:
  - 1. "No Exception Taken".
  - 2. "Exception". All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. Product Data: For each type of air terminal unit.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- C. Shop Drawings: For air terminal units.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.



#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Ceiling suspension assembly members.
  - 2. Size and location of initial access modules for acoustic tile.
  - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- B. Field quality-control reports. See Execution: "Field Quality Control."

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Instructions for resetting minimum and maximum air volumes.
    - b. Instructions for adjusting software set points.
    - c. Instructions for configuring all thermostat settings

### 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

#### 2.2 SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers
  - 1. Titus
  - 2. Price
  - 3. Krueger
  - 4. Or approved Equal

- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Casing: Minimum 22-gauge galvanized steel, 304 stainless steel, or 0.04-inch thick aluminum.
  - 1. Casing Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass duct liner.
  - 2. Attenuator Section Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass duct liner.
  - 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
  - 1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 6 inches w.g. inlet static pressure.
  - 2. Damper Position: Normally closed. Spring return not required.
- E. Hydronic Heating 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.
- F. Velocity Sensor: Multipoint array with velocity sensor in air inlet.
- G. Direct Digital Controls: Single-package unitary controller and actuator specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."

### **2.3 AIR MEASURING STATION WITH INTEGRAL CONTROL DAMPER**

- A. Manufacturers
  - 1. Ruskin AMS050
  - 2. Greenheck
  - 3. Or approved Equal
- B. Fabrication:
  - 1. Frame: Nominal 4 inches x 1 inch x minimum 0.081 inch 6063-T5 extruded aluminum channel control damper frame. Mounting flanges on both sides of frame.
  - 2. Blades:
    - a. Control Damper: Airfoil-shaped, heavy gage, 6063-T5 extruded aluminum.
    - b. Airflow Monitoring: Airfoil-shaped, heavy gage, anodized 6063-T5 extruded aluminum. Fixed in 10 inches x minimum 16 gage galvanized steel frame.
  - 3. Seals:
    - a. Jamb: Flexible metal compression type along control damper sides.
    - b. Blade: Ruskiprene seal along control damper blade edges.

4. Bearings: Molded synthetic.
5. Linkage: Galvanized steel, concealed in frame.
6. Axles: Minimum 1/2 inch diameter plated steel, hex-shaped, mechanically attached to blade.
7. Operating Temperature: -22 to 140 degrees F.
8. Air Straightener Section: 3000 series aluminum alloy honeycomb. Contained in 5 inches long, 16 gage galvanized steel sleeve attached to monitoring blade frame. Flanged as required.
9. Mounting Style: Flanged.
10. Finish: Mill.
11. Assembly: Factory assemble air monitoring station, actuator, options, and accessories.

## **2.4 CASING LINER**

- A. Casing Liner: Fibrous-glass duct liner, complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  1. Minimum Thickness: 1 inch.
    - a. Maximum Thermal Conductivity:
      - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  2. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
- B. Casing Liner: Flexible elastomeric duct liner fabricated of preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
  1. Minimum Thickness: 1 inch.
  2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
  3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

## **2.5 SOURCE QUALITY CONTROL**

- A. Factory Tests: Test assembled air terminal units according to AHRI 880.
  1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

## **PART 3 - EXECUTION**

### **3.1 HANGER AND SUPPORT INSTALLATION**

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- 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.

### **3.2 SEISMIC-RESTRAINT-DEVICE INSTALLATION**

- A. Install hangers and braces designed to support the air terminal units and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7. Comply with requirements for seismic-restraint devices in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on air terminal units that are suspended with vibration isolators.
- E. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- F. Drilling for and Setting Anchors:
  - 1. Identify position of reinforcing steel and other embedded items before drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify Architect 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. Install heavy-duty sleeve anchors with sleeve fully engaged in the structural element to which anchor is to be fastened.
  4. Set anchors to manufacturer's recommended torque, using a torque wrench.
  5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

### **3.3 TERMINAL UNIT 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. Measures shall be taken to protect all unit components from construction dust debris:
  1. Unit interior
  2. Dampers
  3. Actuators, damper and heating valve.
  4. Controller
  5. Thermostats

### **3.4 CONNECTIONS**

- A. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.
- B. Hot-Water Piping: Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties," and 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. Comply with requirements in Section 233113 "Metal Ducts" for connecting ducts to air terminal units.

### **3.5 IDENTIFICATION**

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

### **3.6 FIELD QUALITY CONTROL**

- A. Perform the following 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.
- B. Air terminal unit will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### **3.7 STARTUP SERVICE**

- A. Perform startup service and coordinate with Commissioning Agent. Startup reports should be provided to the Commissioning Agent.
  - 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.

### **3.8 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

**END OF SECTION 23 36 00**

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## SECTION 23 37 13 – DIFFUSERS, REGISTERS, AND GRILLES

### 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 ACTION SUBMITTALS

- A. The manufacturer, contractor or supplier shall resubmit the specification section and shall include a written statement that the submitted equipment, hardware or accessory complies with the requirement of that particular section. Next to each specification item, indicate the following:
  - 1. “No Exception Taken”.
  - 2. “Exception”. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- B. Product Data: For each type of product.
  - 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 and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  - 2. Duct access panels.
- B. Source quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 GRILLES AND DIFFUSERS

- A. See schedules on mechanical drawings for all product requirements.
- B. Contractor to coordinate framing with the ceiling construction.



- C. Contractor to coordinate finishes with architect.
- D. The noise criteria (NC) rating of all grilles and diffusers shall be a maximum of 5 NC points less than the NC criteria of the space it serves. Summary of space NC criteria:
  - 1. Classrooms: NC 30
  - 2. Meeting Room: NC 30
  - 3. Conference Room: NC 25
  - 4. Private Offices: NC 35
  - 5. Architecture 4: NC 40
  - 6. Recording Studio: NC 25
  - 7. Wellness: NC 40
  - 8. Faculty Lounge: NC 40

## **2.2 ACCESSORIES**

- A. Flexible Duct Support
  - 1. Manufacturers: Titus FlexRight (no known equal)
    - a. Radius forming brace to support 4-inch through 16-inch diameter flexible air ducts.
    - b. Provide nylon cable ties to secure flex duct to FlexRight brace.

## **2.3 SOURCE QUALITY CONTROL**

- A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install diffusers 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 with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- D. Install Titus FlexRight brace at all flexible duct-to-diffuser connections.

### **3.3 ADJUSTING**

- A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION 23 37 13**

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## SECTION 23 74 13 – CUSTOM 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 central station air handling units and make-up air units.
- B. Related Sections:
  - 1. Section 230000 “General Mechanical Requirements”
  - 2. Section 230549 “Variable Frequency Motor”
  - 3. Section 233113 "Metal Ducts"
  - 4. Section 233300 "Air Duct Accessories."

#### 1.3 ACTION SUBMITTALS

- A. The manufacturer, contractor or supplier shall include a written statement that the submitted equipment, hardware, or accessory complies with the requirement of this particular specification section.
  - 1. The manufacturer shall resubmit this specification section showing compliance with each respective paragraphs and specified items and features.
  - 2. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
  - 3. Individual or partial submittals are not acceptable and will be returned without review.
- B. Submittals:
  - 1. Manufacturer shall provide the following information with each shop drawing/product data submission:
    - a. All electrical, piping, and ductwork requirements, including sizes, connection locations, and connection method recommendations.
    - b. Each component of the unit shall be identified. Mechanical specifications describing construction, components, and options shall be provided for the unit and all accessories. All performance data, including capacities and airside and waterside pressure drops, for components.
    - c. Fan curves shall be provided for fans with the design operating points indicated. Data shall be corrected to actual operating conditions, temperatures, and altitudes.

- d. A filter schedule must be provided for each air handling unit supplied by the air handling unit manufacturer. Schedule shall detail unit tag, unit size, corresponding filter section location within the AHU, filter arrangement (e.g. angled/flat), filter depth, filter type (e.g. pleated media), MERV rating, and filter quantity and size.
- e. A schedule detailing necessary trap height shall be provided for each air handling unit. Schedule shall detail unit tag, unit size, appropriate trap schematic with recommended trap dimensions, and unit supplied base rail height. Contractor shall be responsible for additional trap height required for trapping and insulation beyond the unit supplied base rail height by adequate housekeeping pad.
- f. An electrical MCA - MOP schedule shall be provided for each electrical circuit to which field-power must be supplied. Schedule to detail unit tag, circuit description, voltage/phase/hertz, Minimum Circuit Ampacity (MCA), and calculated Maximum Overcurrent Protection (MOP).
- g. Variable frequency drive (VFD) and motor data.
- h. Sound Test for the AHU in accordance with AMCA Standard 300-96, Reverberant Room Method for sound testing of fans, and where relevant, AHRI Standard 260-01, Sound Ratings of Ducted Air Moving and Conditioning Equipment.
- i. Airflow measuring device performance ratings in accordance with AMCA 611.
- j. Static pressure profiles by component section.
- k. Casing leakage rate at +/- 10" / [12"] w.g., specified in terms of percentage of design airflow.
- l. Panel deflection data.
- m. Fan balance test data showing calculations for deflection and critical speed of the shaft.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, load distribution, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

#### 1.4 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, tube pull clearances, and service clearances.

B. Certificates: For certification required in "Quality Assurance" Article.

### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For each air handling unit, provide emergency, operation, and maintenance manuals.
- B. Warranty

### **1.6 QUALITY ASSURANCE AND REGULATORY REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. Comply with NFPA 70.
- D. Unit shall bear an ETL label, conforming to UL Standard 1995. Units shall be provided with listing agency label affixed to the unit. In the event the unit is not ETL approved, the contractor shall, at his/her expense, provide for a field inspection by a ETL representative to verify conformance.
- E. Fans shall be AMCA certified for sound and performance in accordance with AMCA 210 – Laboratory Methods of Testing Fans for Rating Purposes and AMCA 300 – Test Code for Sound Rating Air Moving Devices.
- F. AMCA 301 – Method of Publishing Sound Ratings for Air Moving Devices.
- G. AMCA 500 – Test Methods for Louver, Dampers, and Shutters
- H. Certify air handling coils in accordance with AHRI Standard 410. Units shall be provided with certification label affixed to the unit. If air handling coils are not certified in accordance with AHRI Standard 410, contractor shall be responsible for expenses associated with testing of coils after installation to verify performance of coil(s). Any costs incurred to adjust coils to meet scheduled capacities shall be the sole responsibility of the contractor.

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

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Units shall ship fully assembled up to practical shipping and rigging limitations. Units not shipped fully assembled shall have tags and airflow arrows on each section to indicate location and orientation in direction of airflow. Shipping splits shall be clearly defined on submittal drawings. Cost associated with non-conformance to shop drawings shall be the responsibility of the manufacturer. Each section shall have lifting lugs for field rigging, lifting and final placement of AHU section(s).

- C. Deliver units to jobsite with fan motor(s), sheave(s), and belt(s) completely assembled and mounted in units.
- D. Unit shall be shipped in a shrink-wrap or stretch-wrap to protect unit from in-transit rain and debris per ASHRAE 62.1 recommendations.
- E. Installing contractor shall be responsible for storing AHU in a clean, dry place and. Contractor shall protect units from weather, construction traffic, dust, and debris.
- F. Handle unit and componenets carefully to avoid damage to components, enclosures, and finish Protect, pack, and secure controls devices, electronic equipment, loose-shipped devices, electronic or pneumatic devices, and variable frequency devices.

## **1.8 WARRANTY**

- A. Manufacturer shall provide, at no additional cost, a standard parts warranty that covers a period of one year from unit start-up or 18 months from shipment, whichever occurs first. This warrants that all products are free from defects in material and workmanship and shall meet the capacities and ratings set forth in the equipment manufacturer's catalog and bulletins.
- B. Warranty shall cover air handling unit and accessories, excluding routine maintenance parts such as filters and belts.
- C. Contractor shall provide a Labor Warranty that covers a period of one year from unit start-up or 18 months from shipment, whichever occurs first.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Energy Labs
  - 2. Haakon.
  - 3. Temtrol.
  - 4. United Metal Products

### **2.2 MANUFACTURED UNIT**

- A. Manufacturer shall provide outdoor, rooftop, integral base frame unit to support and raise all sections of the unit for proper trapping. Unit base frames not constructed of galvanized steel shall be chemically cleaned and coated with both a rust-inhibiting primer and finished coat of rust-inhibiting enamel. Unit base height to be included in trap

### 2.3 UNIT BASE

- A. Unit base shall be fabricated from ASTM A36 welded structural steel channel or tubular steel. Formed bases are not acceptable. Bases shall be sized as a function of air handling length as follows:

Channel Construction:

Unit Length	Minimum Channel Size	Weight/Foot
Up to 10 feet	4" x 1-5/8"	5.4 lbs/ft
11 to 20 feet	6" x 2"	8.2 lbs/ft
21 to 30 feet	8" x 2-1/4"	11.5 lbs/ft
31 to 40 feet	10" x 2-3/5"	15.3 lbs/ft
41 to 50 feet	12" x 3"	20.7 lbs/ft

Tubular Steel Construction:

Unit Length x Width	Minimum Tube Size
Up to 16 feet x 97" wide	4" x 2"
Up to 20 feet x 139" wide	5" x 2"
Up 25 feet x 181" Wide	6" x 2"
Up to 25 feet x 300" wide	8" x 2"

- B. Frame members shall be sized to limit deflection to L/200, minimizing deflection during rigging and installation. Intermediate tubular steel or C-Channel cross members are fully welded and located at lifting points and as needed to support internal components such as coils, fans, etc. Removable or welded lifting lugs shall be added to the perimeter channel along the longest length of the unit.
- C. Structural floor panels shall be 14-gauge or thicker bright galvanized steel with deep flanges and a maximum panel width of 24" for exceptional rigidity. Flooring shall be welded or screwed to unit frame. All panels shall be fully caulked with a high performance polymer sealant. Sealant shall be low VOC and be free of silicone and isocyanates. Section splits shall be supplied with an upturned bolted flange and u-clip for field connections.
- D. All access section floors shall be covered with 0.125" thick, #3003 aluminum tread plate sheets.
- E. The entire floor and frame shall be foamed with a 2-part polyurethane foam. Minimum foam thickness shall be 2" underneath the base surface and 1/2" on flanges and angles. Provide 20 gauge galvanized steel liner.

### 2.4 UNIT CASING

- A. Housing: The unit housing side and roof panels shall be constructed of 16-gauge galvanized steel, and shall utilize a standing seam modular panel type construction. All floors shall be constructed of 14-gauge or thicker galvanized steel. The panels shall be caulked and attached to each other, to the roof, and to the floor. All panels shall be removable. All seams shall be sealed with an acrylic latex sealant prior to assembling the panels and after completion of the assembly. All floor openings shall have 12 gauge galvanized steel-framed flange around the entire perimeter of



opening for duct connection. The casing structure shall incorporate insulating thermal breaks as required so that, when fully assembled, there exists no path of continuous unbroken metal to metal conduction from inner to outer surfaces.

- B. Minimum sound transmission loss (STL) through unit panels shall be as follows:

OCTAVE BAND CENTER FREQUENCY					
125	250	500	1K	2K	4K
25	29	36	42	47	48

- C. Outdoor units shall have roofs with a minimum of ¼" per foot slope to insure no standing water.
- D. Insulation and Interior Liner: Insulation shall be 2" thick, 3 lbs per cubic foot density, neoprene coated fiberglass to cover all walls and ceilings of each section. This insulation shall meet NFPA-90A smoke and flame spread requirements. All floors shall be insulated from below using minimum 1" thick foam to insure that the entire under surface of the floor is insulated. There shall be no raw edges of insulation exposed to the air stream. The entire interior of all units shall be lined with minimum 20 gauge bright galvanized steel liner. The interior liner of the fan sections, inlet plenum sections, and discharge plenum sections shall be perforated and the remaining shall be steel.
- E. Paint Finish: After final assembly the unit exterior shall be coated with an industrial grade high solids polyurethane paint. In addition, all fan bases, springs and structural steel supports shall be coated with the same finish. The paint system shall meet AISTM B Salt spray test for 5000 hours in a 5% solution. Paint shall be applied in an environmentally sealed paint chamber specifically designed for paint application. Manufacturers without paint booth facilities shall use pre-painted 16 gage steel that meets ASTM B117 5000 hr salt spray testing.

## 2.5 ACCESS DOORS

- A. All access doors shall be hinged, double wall, and insulated with the same material as the unit casing. Person-size access doors shall be provided in all sections requiring access for maintenance or service. The frame shall be constructed of extruded aluminum, fully welded at the corners with an anodized finish. The doors shall utilize a dual gasket seal system. All hardware provided shall be non-corrosive and all hinges and latches shall be adjustable with nuts and bolts. Access door must not leak more than 25 CFM @ 6" static pressure.
- B. Door hinges and latches shall be easily adjustable, without the use of shims or special tools, to allow for a tight seal between the door and the doorframe as the gasketing material compresses over time.
- C. All doors shall open against pressure to ensure an airtight seal and to prevent a safety hazard. The door hinge design shall allow for field reversing of door swing and doors shall be easily removable. Provide door detail drawing with submittal package.
- D. Doors entering into any section of the air handler that contains rotating fans shall be provided with a door interlock safety switch to de-energize the fan motor upon opening. All doors must swing against the air pressure (i.e., positive pressure plenum doors must swing in).

- E. All access doors shall include an 8" x 12" wire reinforced UV protected glass view window.
- F. All access doors shall include instrument test holes to enable measurement of pressure drop across unit components. Test ports shall have a removable cover that completely seals the door penetration when testing and balancing is not being conducted.
- G. Door latches and handles shall be constructed of corrosion-resistant material. Corrosion-resistant and UV-resistant material shall be used for outdoor applications.

## **2.6 FANS**

- A. Supply and return fans shall be direct drive Arrangement #4 plenum fans. Fan wheels shall be aluminum with aluminum extruded airfoil blades. The fan inlet shall be isolated from the cabinet by means of a neoprene-coated flexible connection. Plenum fans shall be provided with spring-style thrust restraints.
- B. Each fan shall be sized to perform as indicated on the equipment schedule. The wheel diameter shall not be less than that shown on the equipment schedule. The fan shall be constructed to AMCA Standards for the Class Rating as indicated on the Equipment Schedule.
- C. Fan Base, Spring Isolation, and Support Framing: Mount fan and motor on an internal, fully welded, rigid steel base. Base shall be free-floating at all four corners on spring type isolators with earthquake restraints. The fan assembly shall be isolated from the cabinet by steel springs with minimum deflection of 1.0" or as indicated on schedules. The spring isolators shall be mounted to structural steel members. All isolators shall be rated for Seismic Zone 4 requirements. The spring isolators shall be mounted on a waffle pad for vibration isolation.
- D. Balancing: The fan shaft shall be sized not to exceed 75% of the first critical speed for maximum RPM of Class specified. The critical speed will refer to the top of the speed range of the fans' AMCA class. The lateral static deflection shall not exceed 0.003" per foot of the length of the shaft. Fans shall be balanced to ISO standard G6.3. A copy of the balance test data for this project showing calculations for deflection and critical speed of the shaft and wheel assembly shall be submitted to the engineer and a copy forwarded to the Owner.
- E. Fan bearings are to have a minimum average life (L50) of 200,000 hours per ANSI/ABMA 9 or ANSI/ABMA 11 for ball bearings and roller bearings, respectively.
- F. All fan bearings shall have grease fittings extended to an accessible location.
- G. Fan Airflow Measurement
  - 1. Manufacturer shall be Ebtron, Fan Inlet Hybrid Series or approved equal.
  - 2. Fan shall have a sensor face-mounted at the inlet cone without affecting fan performance or sound. Each sensor node shall be shall contain two individually wired, hermetically sealed bead-in-glass thermistors. Airflow accuracy shall be + 2% of reading over the entire operating airflow range of not less than 0 to 5,000 fpm.
  - 3. The transmitter shall have an integral, minimum 16-character LCD display capable of simultaneously displaying total airflow and temperature. The LCD display shall also be

capable of displaying individual airflow and temperature readings of each independent sensor node.

4. Output signal 4-20 mA. DC or 0-5 VDC standard.
5. The transmitter shall be housed in a NEMA 1 enclosure with external signal tubing, power and output signal connections.

## **2.7 MOTORS AND DRIVES**

- A. All motors and drives shall be factory-installed and run tested.
- B. All motors and drives shall be factory-installed and run tested. Motors shall be premium efficiency, TEFC, NEMA frame, ball bearing type motors.
- C. Fan motors shall be factory wired to an external VFD with flexible conduit of adequate length so that it will not have any effect on the vibration isolation.
- D. Provide motor shaft grounding for all motors connected to VFDs.

## **2.8 COILS**

- A. All coils shall be of the plate fin extended surface type. Tubes shall be 5/8" outside diameter seamless copper with a 0.020" minimum wall thickness. Each coil shall have individually replaceable return bends of 0.025" wall thickness on both sides of the coil. Coils incorporating a "hairpin" type design are not acceptable. Tubes shall be expanded into the fin collars to provide a permanent mechanical bond.
- B. The secondary surface shall be formed of 0.075" aluminum fins and shall be spaced not closer than 10 fins per inch with integral spacing collars that cover the tube surface. Coil secondary surface shall be protected from corrosive environments by ElectroFin E-Coat. Headers shall be non-ferrous seamless copper, outside the air stream and provided with brazed copper male pipe connections. Drain and vent tubes shall be extended to the exterior of the air handling unit.
- C. All coils shall have counter flow construction. Provide left or right hand coil connections as shown and coordinated with the bid documents and submitted for review. The use of internal restrictive devices to obtain turbulent flow will not be accepted.
- D. Coil casings shall be of minimum 16-gauge, 316 stainless steel with double-formed 1-1/4" stacking flanges and 3/4" flanges on the side plates. All other coil casing shall be of 16-gauge galvanized steel. Flanged tube sheets shall have extruded tube holes to prevent raw edges of tube sheets cut into copper tubes because of thermal expansion of tubes in tube holes. Tube holes with raw sheet metal edges are not acceptable. Reinforcing shall be furnished so that the unsupported length is not over 60". All coil assemblies shall be tested under water at 300 psi and rated for 150-psi working pressure. Headers are to be located inside the cabinet casing with only the pipe connections extending through the casing. All sides of coils shall be carefully blanked off with the same materials used for the coil casings, to ensure all air passes through the coil.

- E. Intermediate condensate pans are to be furnished on multiple coil units and single coils greater than 48" high. The pans shall be 16Ga. 316 stainless steel and drain to the main drain pan through copper downspouts.
- F. All water coils shall be rated in accordance with ARI Standard 410. The air handling unit manufacturer, for the purpose of sole source responsibility, shall manufacture all coils supplied for the air handlers.

## **2.9 PRIMARY DRAIN PANS**

- A. The drain pan shall be designed in accordance with ASHRAE 62.1 being of sufficient size to collect all condensation produced from the coil and sloped in three planes, pitched toward drain connections, promoting positive drainage to eliminate stagnant water conditions when unit is installed level and trapped per manufacturer's requirements.
- B. Cooling coil section shall be provided with a 16 gauge, 316 stainless steel drain pan. The drain pan shall be insulated beneath the surface with 2.0", 2-part polyurethane insulation to prevent condensation under the drain pan.
- C. Coil support members inside the drain pan shall be 10 gauge, #316 stainless steel.
- D. The outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.
- E. All drain pan threaded connections shall be visible external to the unit and shall discharge at the side of the unit.
- F. Drain connections shall be of the same material as the primary drain pan and shall extend a minimum 2-1/2-inch beyond the base to ensure adequate room for field piping of condensate traps.
- G. Provide left or right hand coil connections as shown and coordinated with the bid documents and submitted for review.

## **2.10 FILTERS**

- A. Filter sections shall be fabricated as part of the air-handling unit. Filters shall be arranged for upstream loading as shown on the drawings. Provide filter-holding frames to accommodate scheduled filters. Filter frames shall be 16 Ga. galvanized steel and shall be fully welded to reduce leakage of air through corners. Internal blank-offs shall be provided by the air handling unit manufacturer as required to prevent air bypass around the filters.
- B. All air filters shall be State Fire Marshal approved and listed type. Preformed filters having combustible framing shall be tested as a complete assembly. Air filters in all occupancies shall be Class 2 or better, as shown in the State Fire Marshal listing. Air filters shall be accessible for cleaning or replacement.
- C. Filters shall be of the quantities and sizes as indicated on the drawings.

- D. Provide one set of additional startup pre-filters.
- E. Provide factory installed Setra 267 digital filter gauge with LCD display or Engineer approved equal at each filter bank.
  - 1. Gauge shall be complete with static pressure tips, hardware and fittings.
  - 2. Enclose the gauge in a protective sheet metal box with a hinged inspection door. Paint to match unit.
  - 3. Provide IP65/NEMA 4 rated enclosure. All transmitters shall be mounted outside the unit for access.

## **2.11 ECONOMIZER, MINIMUM OA, RETURN and RELIEF AIR DAMPER SECTION**

- A. Economizer section shall include dampers for return air, fresh air and exhaust air. Dampers shall be opposed blade type. Dampers shall be sized for not greater than 1200 fpm face velocity based upon gross damper area. Furnish full height 24" wide access doors for damper and linkage service.
- B. Dampers shall be supplied with low leak extruded aluminum airfoil blades. Blades shall be supplied with rubber edge seals and stainless steel arc end seals. Rubber edge seals shall be backed by the damper blade to assure a positive seal in the closed position. Dampers shall be provided with nylon bearings within extruded openings. Damper leakage shall not exceed 6 CFM/ft<sup>2</sup> at 5.0" of static pressure. Leakage testing shall be in accordance with AMCA standard 500 figure 5.5. Test results must be from independent testing laboratory.
- C. Provide louvers for outside air and exhaust air for units located outdoors. OA Louvers shall be sized for a maximum face velocity of 750 fpm and exhaust air louvers shall be sized for a maximum face velocity of 800 fpm based on gross louver area. Louvers shall have zero water penetration at 600-ft/min air velocity. Maximum louver pressure drop shall be 0.03" in w. g. at 700 ft/min. Provide test results from independent testing laboratory. Test must be conducted in accordance to AMCA Standard 500 figure 5.5. Louver water carry over must be less than 0.01 oz/ft<sup>2</sup> at 1100 ft/min of free louver area. Test must be conducted by independent testing laboratory per AMCA 500-89 figure 5.6. Hoods in lieu of louvers are not acceptable.
- D. Damper shall be heavy duty type.

## **2.12 OUTSIDE AIR DAMPER AIR FLOW MONITORING SECTION**

- A. The OA dampers shall have individual EBTRON, Inc "Gold Series" Model GTC116-PC airflow measuring devices or equal.
- B. Each airflow-temperature measuring device shall consist of one or more sensor probes and a single, remotely mounted, 32 bit microprocessor-based transmitter capable of independently processing up to 16 independently wired sensor nodes contained in one or more probe assemblies per measurement location.
- C. Probes shall be constructed of extruded, gold anodized, 6063 aluminum tubes. All internal wires within the tube shall be Kynar coated. PVC insulated conductors are not acceptable.

- D. Each sensor node shall contain two individually wired, hermetically sealed bead-in-glass thermistors.
- E. Thermistors shall be mounted in the sensor node using a marine-grade, waterproof epoxy. Thermistor leads shall be protected and not exposed to the environment. Thermistors leads shall not be fastened to the thermistor semiconductor substrate by weld or solder connections. Manufacturer shall provide UL listed, FEP jacketed, plenum rated cable(s) between sensor probes and the remote transmitter.
- F. The airflow rate at each sensor node shall be equally weighted and arithmetically averaged by the transmitter prior to output. All integrated circuitry shall be temperature rated as 'industrial-grade'. Submissions containing 'commercial-grade' integrated circuitry are not acceptable.
- G. Each sensing node shall be individually wind tunnel calibrated at 16 points to NIST traceable airflow standards. Airflow accuracy shall be +/-2% of Reading over the entire operating airflow range of not less than 0 to 5,000 fpm (25.4 m/s).
- H. The transmitter shall have an integral LCD display capable of simultaneously displaying airflow and temperature. Individual airflow and temperature readings of each independent sensor node shall be accessible. The transmitter shall be capable of field configuration and diagnostics using an on-board pushbutton interface and LCD display.
- I. The transmitter shall have two isolated and fused analog output signals and one RS-485 network connection. One analog output shall be for velocity and the other for a temperature output or LEED alarm function. All transmitters shall have integral self-diagnostics.
- J. Other than the thermistor sensors, no other electronic components shall be located at the sensing node. Signal processing circuitry on or in the sensor probe shall not acceptable.
- K. Devices using chip-in-glass, epoxy-coated or diode-case chip thermistors are not acceptable.
- L. Devices with RJ-45 connections exposed to the environment or having electronic circuitry mounted in or at the sensor node are not acceptable.
- M. Pitot tubes and arrays are not acceptable.
- N. Vortex shedding devices are not acceptable.
- O. The transmitter shall be mounted outside the unit for access.

### **2.13 VARIABLE FREQUENCY DRIVES (VFDS)**

- A. Refer to Specification Section 230549 VARIABLE FREQUENCY MOTOR CONTROLLERS for additional requirements.
- B. All standard and optional features, such as VFD bypass or redundant VFD's, shall be included within the VFD enclosure. The VFDS shall be UL listed. The listing shall allow mounting in plenum or other air handling compartments.

- C. For redundant VFD's, provide control wiring and control circuitry to manually (or automatically) transfer from main VFD's to redundant VFD when main drive has faulted.
- D. Each VFD shall have its own means of disconnect either by circuit breaker or fused disconnect.
- E. VFD's shall be mounted on (or in) the air handling unit in single NEMA 3R hinged enclosure.
  - 1. VFD input and output power shall be installed in separate conduits.
- F. Provide separate motor overload panel with individual motor overloads and factory wired to the motors with a single point of connection for the VFD.
- G. An appropriate means of VFD cooling shall be provided for recessed mounted or NEMA 3R Rated enclosures.

#### **2.14 UNIT MOUNTED CONTROLS**

- A. All controls shall be field installed by the installing temperature controls contractor and coordinated with the new building automation system. These controls shall include all damper actuators, temperature sensors, pressure sensors, filter switches and other sensors as indicated on the control drawings. Exception: fan airflow measurement sensors and outside air damper airflow monitoring stations shall be installed by the AHU manufacturer and wired by the controls contractor.
- B. Electric and electronic controls shall be wired to a terminal block in a sheet metal enclosure located at a common location mounted on the air handling unit. All pressure sensing controls shall be piped to a common point on the unit with 1/4" compression fittings.
- C. Wiring for chilled water and hot water control valves shall be field supplied by the installing contractor. Control valve wiring shall be extended to an external junction box located near the coil connections with the final wiring connection done by the temperature controls contractor. All control valves and piping specialties shall be provided by the temperature controls contractor and/or piping contractor.
- D. Unit shall include factory installed conduit between sections and split for controls ready construction. If the unit requires splitting; junction boxes shall be furnished on each section to allow the control contractor to make final connections in the field. Wiring shall be clearly labeled to allow ease in final interconnections.
- E. All controls shall be supplied and installed by the Division 230900 temperature controls contractor. Exception: fan airflow measurement sensors and outside air damper airflow monitoring stations shall be installed by the AHU manufacturer and wired by the controls contractor.
- F. Electrical contractor shall bring separate 120/1/60 power for controls.

## **2.15 ELECTRICAL REQUIREMENTS**

- A. Provide single source power panels (SSPP's) that are constructed according to CEC regulations and carry a U.L. listing and label. The panel shall include a non-fused main disconnect switch covering all fans in each unit, VFD's for variable volume units, and any necessary transformers, Hand-Off-Auto switches, relays and pilot lights for complete operation of the fans in the unit. The single source power panels shall be factory wired to all factory furnished devices such as motors and interlocks.
- B. The air handling unit manufacturer, for the purpose of sole source responsibility, shall manufacture all electrical panel assemblies supplied for the air handlers.
- C. The main control panel shall have access door(s) for direct access to the controls. The panel shall be NEMA type 3R (rainproof) and shall contain a single externally operated, non-fused disconnect, suitable for copper wire up to and including 3" conduit. The electrical contractor shall bring separate 460/3/60 power to the single source power panel.
- D. All wiring shall be run in EMT conduit (or flexible when connecting to a motor). Raceways are not acceptable.
- E. Provide fluorescent marine style lights in each access section wired to a common weatherproof switch with 60 minute timer mounted adjacent to the supply fan access door. 120V GFI duplex service receptacles shall be installed and wired with the lighting circuit and located at each fan compartment. The electrical contractor shall bring separate 120/1/60 power to this circuit connected at the supply fan GFI outlet.

## **2.16 UNIT SOUND POWER LEVELS**

- A. Provide sound power level data for the unit that will be supplied.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas and conditions for compliance with requirements for installation tolerances, and other conditions affecting performance of equipment.
- B. Verify that roof is ready to receive Work and opening dimensions are as illustrated by the manufacturer.
- C. Verify that proper power supply is available.
- D. Verify that the required mechanical services are in place.



### **3.2 INSTALLATION**

- A. Install air handling units and accessories plumb and level in accordance with manufacturer's instructions.
- B. Contractor shall install final filters after construction is complete.
- C. Contractor shall replace pre-filter after construction is complete.
- D. Mechanical contractor shall coordinate with Electrical contractor for:
  - 1. Separate 460v/3ph/60Hz power to the single source power panel.
  - 2. Separate 120v/1ph/60Hz power to the externally mounted light switch and convenience outlet.
  - 3. Separate 120v/1ph/60Hz power to the control panel.

### **3.3 UNIT SHUTDOWN**

- A. Contractor shall provide duct smoke detector in main supply air duct from air handling unit or air moving equipment with supply air in excess of 2,000 CFM. Smoke detector shall shut down the air handling unit or air moving equipment when smoke is detected. Connect smoke detector to the building fire alarm system.

### **3.4 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 condensate drain pans using pipe sizes indicated on drawings, Type L copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- D. Hot and Chilled-Water Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Connect piping to air-handling units with flexible connectors.
- E. Coordinate duct installations and specialty arrangements with schematics on Drawings and with requirements specified in Section 233113 "Metal Ducts" and Section 233300 "Air Duct Accessories."
- F. Connect duct to air-handling units with flexible connections. Comply with requirements of Division 23 Section "Air Duct Accessories."

### **3.5 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. Tests and Inspections:
- C. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.
- D. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- E. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.
- F. Prepare test and inspection reports.

### **3.6 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service. Do not operate unit until all manufacturer-recommended pre-startup checks have been completed and fan has been test run under observation.
- B. Complete installation and startup checks according to manufacturer's written instructions.
- C. Verify that shipping, blocking, and bracing are removed.
- D. 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.
- E. Verify that safeties and interlocks, including high and low pressure switches and freeze protection sensors, have been installed and are operational.
- F. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards when belts are used.
- G. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
- H. Verify that zone dampers fully open and close for each zone.
- I. Verify that outdoor and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
- J. Verify that ducts are clean.
- K. Comb coil fins for parallel orientation.
- L. Install new, clean filters.

- M. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- N. Engage a factory-authorized manufacturer's service representative to performance factory certified VFD start-up. Starting procedures for air-handling units include the following:
- O. Energize motor; verify proper operation and rotation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.
- P. Measure and record motor electrical values for voltage and amperage.
- Q. Manually operate dampers from fully closed to fully open position and record fan performance.

### **3.7 ADJUSTING**

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

### **3.8 CLEANING**

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust.
- B. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

### **3.9 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

**END OF SECTION 23 74 13**

## SECTION 23 74 14 – SEMI-CUSTOM 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 central station air handling units and make-up air units.
- B. Related Sections:
  - 1. Section 230000 "General Mechanical Requirements"
  - 2. Section 230549 "Variable Frequency Motor"
  - 3. Section 233113 "Metal Ducts"
  - 4. Section 233300 "Air Duct Accessories."

#### 1.3 GENERAL DESCRIPTION

- A. This section includes the design, controls, and installation requirements for semi-custom air handling units.

#### 1.4 ACTION SUBMITTALS

- A. The manufacturer, contractor or supplier shall include a written statement that the submitted equipment, hardware, or accessory complies with the requirement of this particular specification section.
  - 1. The manufacturer shall resubmit this specification section showing compliance with each respective paragraphs and specified items and features.
  - 2. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
  - 3. Individual or partial submittals are not acceptable and will be returned without review.
- B. Submittals:
  - 1. Manufacturer shall provide the following information with each shop drawing/product data submission:
    - a. All electrical, piping, and ductwork requirements, including sizes, connection locations, and connection method recommendations.

- b. Each component of the unit shall be identified. Mechanical specifications describing construction, components, and options shall be provided for the unit and all accessories. All performance data, including capacities and airside and waterside pressure drops, for components.
- c. Fan curves shall be provided for fans with the design operating points indicated. Data shall be corrected to actual operating conditions, temperatures, and altitudes.
- d. A filter schedule must be provided for each air handling unit supplied by the air handling unit manufacturer. Schedule shall detail unit tag, unit size, corresponding filter section location within the AHU, filter arrangement (e.g. angled/flat), filter depth, filter type (e.g. pleated media), MERV rating, and filter quantity and size.
- e. A schedule detailing necessary trap height shall be provided for each air handling unit. Schedule shall detail unit tag, unit size, appropriate trap schematic with recommended trap dimensions, and unit supplied base rail height. Contractor shall be responsible for additional trap height required for trapping and insulation beyond the unit supplied base rail height by adequate housekeeping pad.
- f. An electrical MCA - MOP schedule shall be provided for each electrical circuit to which field-power must be supplied. Schedule to detail unit tag, circuit description, voltage/phase/hertz, Minimum Circuit Ampacity (MCA), and calculated Maximum Overcurrent Protection (MOP).
- g. Motor data.
- h. Sound Test for the AHU in accordance with AMCA Standard 300-96, Reverberant Room Method for sound testing of fans, and where relevant, AHRI Standard 260-01, Sound Ratings of Ducted Air Moving and Conditioning Equipment.
- i. Airflow measuring device performance ratings in accordance with AMCA 611.
- j. Static pressure profiles by component section.
- k. Casing leakage rate at +/- 10" [12"] w.g., specified in terms of percentage of design airflow.
- l. Panel deflection data.
- m. Fan balance test data showing calculations for deflection and critical speed of the shaft.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, load distribution, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring 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, tube pull clearances, and service clearances.

- B. Certificates: For certification required in "Quality Assurance" Article.

## **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For each air handling unit, provide emergency, operation, and maintenance manuals.
- B. Warranty

## **1.7 QUALITY ASSURANCE AND REGULATORY REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. Comply with NFPA 70.
- D. Unit shall bear an ETL label, conforming to UL Standard 1995. Units shall be provided with listing agency label affixed to the unit. In the event the unit is not ETL approved, the contractor shall, at his/her expense, provide for a field inspection by a ETL representative to verify conformance.
- E. Fans shall be AMCA certified for sound and performance in accordance with AMCA 210 – Laboratory Methods of Testing Fans for Rating Purposes and AMCA 300 – Test Code for Sound Rating Air Moving Devices.
- F. AMCA 301 – Method of Publishing Sound Ratings for Air Moving Devices.
- G. AMCA 500 – Test Methods for Louver, Dampers, and Shutters
- H. Certify air handling coils in accordance with AHRI Standard 410. Units shall be provided with certification label affixed to the unit. If air handling coils are not certified in accordance with AHRI Standard 410, contractor shall be responsible for expenses associated with testing of coils after installation to verify performance of coil(s). Any costs incurred to adjust coils to meet scheduled capacities shall be the sole responsibility of the contractor.

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

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Units shall ship fully assembled up to practical shipping and rigging limitations. Units not shipped fully assembled shall have tags and airflow arrows on each section to indicate location and orientation in direction of airflow. Shipping splits shall be clearly defined on submittal drawings. Cost associated with non-conformance to shop drawings shall be the responsibility of the manufacturer. Each section shall have lifting lugs for field rigging, lifting and final placement of AHU section(s).

- C. Deliver units to jobsite with fan motor(s), sheave(s), and belt(s) completely assembled and mounted in units.
- D. Unit shall be shipped in a shrink-wrap or stretch-wrap to protect unit from in-transit rain and debris per ASHRAE 62.1 recommendations.
- E. Installing contractor shall be responsible for storing AHU in a clean, dry place and. Contractor shall protect units from weather, construction traffic, dust, and debris.
- F. Handle unit and componenets carefully to avoid damage to components, enclosures, and finish Protect, pack, and secure controls devices, electronic equipment, loose-shipped devices, electronic or pneumatic devices, and variable frequency devices.

## **1.9 WARRANTY**

- A. Manufacturer shall provide, at no additional cost, a standard parts warranty that covers a period of one year from unit start-up or 18 months from shipment, whichever occurs first. This warrants that all products are free from defects in material and workmanship and shall meet the capacities and ratings set forth in the equipment manufacturer's catalog and bulletins.
- B. Warranty shall cover air handling unit and accessories, excluding routine maintenance parts such as filters and belts.
- C. Contractor shall provide a Labor Warranty that covers a period of one year from unit start-up or 18 months from shipment, whichever occurs first.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURER**

- A. Products shall be provided by the following manufacturers:
  - 1. Dunham Bush
  - 2. Trane
  - 3. Or approved equal

### **2.2 AIR HANDLING UNITS**

- A. General Description
  - 1. Indoor air handling units shall include filters, supply fans, return fans, heating hot water coil and chilled water coil.
  - 2. The units are to be completely factory assembled and blower run tested and shipped as one complete unit or in sections as shown to facilitate handling.
  - 3. The units shall be built in accordance with all applicable national codes including the National Electrical Code and UL1995.

**B. Construction**

1. Units will be designed for maximum strength being rigidly constructed in modules each section of extruded aluminum structural profile with strong nylon corners complete with external isolator and rigging supports. The entire assembly shall be fabricated from galvanized steel or coated with manufacturer's standard paint finish meeting ASTM B-117, 1,000 hour (minimum) salt spray. Galvanized steel shall be UL-090U approved.
2. Standard unit equipped with roof panel, air hood for air intake, stainless steel external fastener and RT access door for weatherproofing. The roof panels are pitched to the casing side with 1 ½" overhang to avoid rainwater flowing from roof panel drip onto the panel or door tops. Air hood is furnished for air intake, covered with standard bird screen made of wire mesh or aluminum flat filter available as option. RT access door is designed with double gasket. One layer of gasket is applied to the frame and there is another layer applied directly to the door.

**C. Unit Casing, Frame, and Insulation**

1. Unit framework shall be of extruded aluminum structural section construction, joined with nylon corner to form rigid structure. Unit shall be 2" double-wall construction. Each panel shall be formed as an individually removable, rigid member. Base angles shall be structurally formed and to be of extruded aluminum structural section construction. Galvanized steel or manufacturer's standard paint acceptable.
2. All wall, floor and roof panels shall be a minimum of 18 gauge galvanized steel exterior casing and 20 gauge galvanized steel inner liner.
3. Unit base to be designed for floor mounting or ceiling suspensions. Minimum ¼" x 2 ½" x 2 ½" structural steel shall extend beyond unit casing for isolation mounting or ceiling suspension.
4. Panels shall be fastened in such a way to minimize loosening due to vibration or stripping of fastener threads.
5. Casing to be completely insulated with 2" polyurethane foam with neoprene facing. Insulation shall be NFPA 90A approved. 2" panels shall have a R-value of R-16.3.

**D. Access doors**

1. Access door shall be provided on all sections. Fan and angle filter section doors shall be a minimum of 18 inches in width.
2. Access doors shall be full size, of 2" double-wall construction with 20 gauge galvanized steel construction with solid inner liner. Access door panels shall be easily removable by air tight screwed compression latch. Gasketing shall be rigid PVC strip and PE foam to provide air-tight casing and minimize cold bridging or equivalent.

**E. Fan Section**

1. Supply and return fans shall be direct-drive single inlet centrifugal fans with backwards-curved high-performance centrifugal impellers with radial diffusers, mounted on a GreenTech EC external rotor motor with integrated control electronics
2. Impeller made of aluminum, with 5 backwards-curved, continuously welded, hollow-profile blades; flow-optimized inlet ring made of galvanized sheet steel with pressure test nipple.



3. Motor impeller statically and dynamically balanced on two planes to balancing grade G 6.3 in accordance with DIN ISO 1940.
4. GreenTech EC external rotor motor surpasses efficiency class IE4, magnets with no rare earths, maintenance-free ball bearings with long-term lubrication, theoretical nominal service life of at least 40,000 hours of operation.
5. Motor shall be wired to external box on supply fan section for power and control wiring.
6. Integrated protective devices:
  - a. Alarm relay with zero-potential change-over contacts (250 V AC/2 A,  $\cos w = 1$ )
  - b. Locked-rotor protection
  - c. Phase failure detection
  - d. Soft start of motors
  - e. Mains under-voltage detection
  - f. Thermal overload protection for electronics and motor
  - g. Short circuit protection

**F. Fan Airflow Measurement**

1. Manufacturer shall be Ebtron, Fan Inlet Hybrid Series or approved equal.
2. Fan shall have a sensor face-mounted at the inlet cone without affecting fan performance or sound. Each sensor node shall be shall contain two individually wired, hermetically sealed bead-in-glass thermistors. Airflow accuracy shall be + 2% of reading over the entire operating airflow range of not less than 0 to 5,000 fpm.
3. The transmitter shall have an integral, minimum 16-character LCD display capable of simultaneously displaying total airflow and temperature. The LCD display shall also be capable of displaying individual airflow and temperature readings of each independent sensor node.
4. Output signal 4-20 mA. DC or 0-5 VDC standard.
5. The transmitter shall be housed in a NEMA 1 enclosure with external signal tubing, power and output signal connections.

**G. Cooling coil section:**

1. Cooling coil section shall have a full size insulated primary drain pan extending under header connections and downstream of cooling coil.
2. Primary drain pan shall have a drain connection extended through unit base.
3. Drain pan shall be of stainless steel, double wall construction and fully insulated. Drain pan shall be pitched to provide a positive drain of condensation to minimize standing water.
4. When stacked coils are required, an intermediate drain pan is to be furnishing with drains extending to the primary drain pan. Coils must be removable through the access panels.
5. All connection, including supply, return, vent and drain shall terminate outside the air handler cabinet. Cabinet penetrations shall be gasket.

**H. Coils**

1. Coil face velocity shall not exceed 400 feet per minute and shall have capacities as shown on unit schedule. Coils shall be of the extended surface type, constructed of 5/8" O.D. copper tubing and plate fins of aluminum with BlyGold PoluAt XT coating. Coils shall be certified as complying with ARI Standard 410. Coils shall be of drainable construction.

Tubes shall be pressure-bonded into fin collars by expanding the tubes. Plate fins shall be die-formed with integral spacing collars that cover the tube surface.

2. Headers shall be seamless copper with steel MPT pipe connections. Coils casing shall be a minimum of 16 gauge 304 stainless steel.
3. Each coil shall be tested at 400 psig air pressure under water.
4. Vent and drain connections shall be factory installed in the return and supply connections respectively.

#### I. Filter Section

1. Pre-filters shall be 35% efficient pleated fiberglass type. Filter face velocities shall not exceed 500 feet per minute. Filter tracks shall be of die formed galvanized steel
2. Final filters shall be rigid cartridge type. Filters shall be 85% efficient by NBS dust spot test. Filters shall be mounted in an extruded aluminum filter track with 1/8" thick construction, incorporating a reinforced nylon pile gasket for positive air seal.
3. Filters shall be of side loading type with access door on side of unit.

#### J. Economizer Section

1. Section shall have parallel outside air, return air and exhaust air dampers.
2. Dampers shall be opposed type; frames shall be constructed of formed 14 gauge galvanized sheet steel. Damper blade shall be airfoil type, constructed of 1/16 in. extruded aluminum. Maximum damper blade width shall not exceed 6 inches. Blade and jamb seals are required on all dampers. Jamb seals shall be self-compensating stainless steel. Blade seal shall be thermoplastic rubber gasket, extend the full length of the blade and along the top and bottom blade stops of each damper. Damper rods shall rotate in frictionless bearings. Damper-to-damper linkage shall be provided with (plain or combination filter/mixing section)(internal or external face and bypass). Dampers shall be designed for shut-off against a 4-inch pressure differential. Dampers shall not have a leakage greater than 0.54 CFM/sq. ft at 1 in. W.G. static pressure. The damper must be rated to operate over a temperature range of -4°F to 176°F (-20°C to 80°C).

#### K. Outside air damper air flow monitoring section

1. The OA dampers shall have individual EBTRON, Inc "Gold Series" Model GTC116-PC airflow measuring devices or equal.
2. Each airflow-temperature measuring device shall consist of one or more sensor probes and a single, remotely mounted, 32 bit microprocessor-based transmitter capable of independently processing up to 16 independently wired sensor nodes contained in one or more probe assemblies per measurement location.
3. Probes shall be constructed of extruded, gold anodized, 6063 aluminum tubes. All internal wires within the tube shall be Kynar coated. PVC insulated conductors are not acceptable.
4. Each sensor node shall contain two individually wired, hermetically sealed bead-in-glass thermistors.
5. Thermistors shall be mounted in the sensor node using a marine-grade, waterproof epoxy. Thermistor leads shall be protected and not exposed to the environment. Thermistors leads shall not be fastened to the thermistor semiconductor substrate by weld or solder connections. Manufacturer shall provide UL listed, FEP jacketed, plenum rated cable(s) between sensor probes and the remote transmitter.

6. The airflow rate at each sensor node shall be equally weighted and arithmetically averaged by the transmitter prior to output. All integrated circuitry shall be temperature rated as 'industrial-grade'. Submissions containing 'commercial-grade' integrated circuitry are not acceptable.
7. Each sensing node shall be individually wind tunnel calibrated at 16 points to NIST traceable airflow standards. Airflow accuracy shall be +/-2% of Reading over the entire operating airflow range of not less than 0 to 5,000 fpm (25.4 m/s).
8. The transmitter shall have an integral LCD display capable of simultaneously displaying airflow and temperature. Individual airflow and temperature readings of each independent sensor node shall be accessible. The transmitter shall be capable of field configuration and diagnostics using an on-board pushbutton interface and LCD display.
9. The transmitter shall have two isolated and fused analog output signals and one RS-485 network connection. One analog output shall be for velocity and the other for a temperature output or LEED alarm function. All transmitters shall have integral self-diagnostics.
10. Other than the thermistor sensors, no other electronic components shall be located at the sensing node. Signal processing circuitry on or in the sensor probe shall not acceptable.
11. Devices using chip-in-glass, epoxy-coated or diode-case chip thermistors are not acceptable.
12. Devices with RJ-45 connections exposed to the environment or having electronic circuitry mounted in or at the sensor node are not acceptable.
13. Pitot tubes and arrays are not acceptable.
14. Vortex shedding devices are not acceptable.
15. The transmitter shall be mounted outside the unit for access.

### **2.3 UNIT MOUNTED CONTROLS**

- A. All controls shall be field installed by the installing temperature controls contractor and coordinated with the new building automation system. These controls shall include all damper actuators, temperature sensors, pressure sensors, filter switches and other sensors as indicated on the control drawings. Exception: fan airflow measurement sensors and outside air damper airflow monitoring stations shall be installed by the AHU manufacturer and wired by the controls contractor.
- B. Electric and electronic controls shall be wired to a terminal block in a sheet metal enclosure located at a common location mounted on the air handling unit. All pressure sensing controls shall be piped to a common point on the unit with 1/4" compression fittings.
- C. Wiring for chilled water and hot water control valves shall be field supplied by the installing contractor. Control valve wiring shall be extended to an external junction box located near the coil connections with the final wiring connection done by the temperature controls contractor. All control valves and piping specialties shall be provided by the temperature controls contractor and/or piping contractor.
- D. Unit shall include factory installed conduit between sections and split for controls ready construction. If the unit requires splitting; junction boxes shall be furnished on each section to allow the control contractor to make final connections in the field. Wiring shall be clearly labeled to allow ease in final interconnections.

- E. All controls shall be supplied and installed by the Division 230900 temperature controls contractor. Exception: fan airflow measurement sensors and outside air damper airflow monitoring stations shall be installed by the AHU manufacturer and wired by the controls contractor.
- F. Electrical contractor shall bring separate 120/1/60 power for controls.

## **2.4 ELECTRICAL REQUIREMENTS**

- A. Provide single source power panels (SSPP's) that are constructed according to CEC regulations and carry a U.L. listing and label. The panel shall include a non-fused main disconnect switch covering all fans in each unit, VFD's for variable volume units, and any necessary transformers, Hand-Off-Auto switches, relays and pilot lights for complete operation of the fans in the unit. The single source power panels shall be factory wired to all factory furnished devices such as motors and interlocks.
- B. The air handling unit manufacturer, for the purpose of sole source responsibility, shall manufacture all electrical panel assemblies supplied for the air handlers.
- C. The main control panel shall have access door(s) for direct access to the controls. The panel shall be NEMA type 3R (rainproof) and shall contain a single externally operated, non-fused disconnect, suitable for copper wire up to and including 3" conduit. The electrical contractor shall bring separate 460/3/60 power to the single source power panel.
- D. All wiring shall be run in EMT conduit (or flexible when connecting to a motor). Raceways are not acceptable.
- E. Provide fluorescent marine style lights in each access section wired to a common weatherproof switch with 60 minute timer mounted adjacent to the supply fan access door. 120V GFI duplex service receptacles shall be installed and wired with the lighting circuit and located at each fan compartment. The electrical contractor shall bring separate 120/1/60 power to this circuit connected at the supply fan GFI outlet.

## **2.5 UNIT SOUND POWER LEVELS**

- A. Provide sound power level data for the unit that will be supplied.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas and conditions for compliance with requirements for installation tolerances, and other conditions affecting performance of equipment.
- B. Verify that roof is ready to receive Work and opening dimensions are as illustrated by the manufacturer.
- C. Verify that proper power supply is available.

- D. Verify that the required mechanical services are in place.

### **3.2 INSTALLATION**

- A. Install air handling units and accessories plumb and level in accordance with manufacturer's instructions.
- B. Contractor shall install final filters after construction is complete.
- C. Contractor shall replace pre-filter after construction is complete.
- D. Mechanical contractor shall coordinate with Electrical contractor for:
  - 1. Separate 460v/3ph/60Hz power to the fans.
  - 2. Separate 120v/1ph/60Hz power to the externally mounted light switch and convenience outlet.
  - 3. Separate 120v/1ph/60Hz power to the control panel.

### **3.3 UNIT SHUTDOWN**

- A. Contractor shall provide duct smoke detector in main supply air duct from air handling unit or air moving equipment with supply air in excess of 2,000 CFM for specific units indicated on the drawings. Smoke detector shall shut down the air handling unit or air moving equipment when smoke is detected. Connect smoke detector to the building fire alarm system.

### **3.4 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 condensate drain pans using pipe sizes indicated on drawings, Type L copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- D. Hot and Chilled-Water Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Connect piping to air-handling units with flexible connectors.
- E. Coordinate duct installations and specialty arrangements with schematics on Drawings and with requirements specified in Section 233113 "Metal Ducts" and Section 233300 "Air Duct Accessories."
- F. Connect duct to air-handling units with flexible connections. Comply with requirements of Division 23 Section "Air Duct Accessories."

### **3.5 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. Tests and Inspections:
- C. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.
- D. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- E. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.
- F. Prepare test and inspection reports.

### **3.6 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service. Do not operate unit until all manufacturer-recommended pre-startup checks have been completed and fan has been test run under observation.
- B. Complete installation and startup checks according to manufacturer's written instructions.
- C. Verify that shipping, blocking, and bracing are removed.
- D. 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.
- E. Verify that safeties and interlocks, including high and low pressure switches and freeze protection sensors, have been installed and are operational.
- F. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards when belts are used.
- G. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
- H. Verify that zone dampers fully open and close for each zone.
- I. Verify that outdoor and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
- J. Verify that ducts are clean.
- K. Comb coil fins for parallel orientation.

- L. Install new, clean filters.
- M. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- N. Engage a factory-authorized manufacturer's service representative to performance factory certified start-up. Starting procedures for air-handling units include the following:
- O. Energize motor; verify proper operation and rotation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.
- P. Measure and record motor electrical values for voltage and amperage.
- Q. Manually operate dampers from fully closed to fully open position and record fan performance.

### **3.7 ADJUSTING**

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

### **3.8 CLEANING**

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust.
- B. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

### **3.9 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

**END OF SECTION 23 74 14**

## **SECTION 23 74 15 – AIR HANDLING UNIT NOISE REQUIREMENTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

#### **1.2 SUMMARY**

- A. The air-handling equipment manufacturer shall furnish factory supplied data showing the sound power levels for the AHU casing, supply air discharge and return air inlet openings for each air-handling unit.

#### **1.3 REFERENCES**

- A. ARI Standard 260, Sound Rating of Ducted Air Moving and Conditioning Equipment or a test standard approved by the acoustical consultant. Equivalent test and calculation procedures may be substituted for the above procedures if approved in advance by the Architect. The sound power level of each air-handling units supply air discharge, return air inlet, and exhaust air noise shall not exceed the values list in the schedule below when operating at the maximum design airflow and static pressure conditions.

#### **1.4 SUBMITTALS**

- A. Submit octave band sound power level data at the design airflow and static pressure conditions for the casing, supply air discharge openings and return air openings for each scheduled air-handling unit. All acoustic data shall be measured and provided in accordance with ARI 260 – Standard Sound Rating of Ducted Air Moving and Conditioning Equipment or a test standard approved by the project Acoustical Consultant. Alternate test procedures must be substituted for review and approval by the Acoustical Consultant in advance of product submission.

### **PART 2 - PRODUCTS**

#### **2.1 AIR HANDLER UNIT SOUND POWER LEVELS**

- A. The sound power levels of each air-handling unit's casing, supply air discharge and return air inlet openings shall not exceed the values list in the schedule below when operating at the maximum design airflow and static pressure conditions.



OCTAVE BAND SOUND POWER LEVELS (Lw), (dB re: 10 <sup>-12</sup> Watts)								
	63	125	250	500	1000	2000	4000	8000
AHU-1								
SA discharge	80	78	83	72	71	71	66	59
RA inlet	73	81	79	69	63	66	63	54
OSA	78	78	88	70	67	70	69	67
EXH	78	79	81	68	67	66	63	59
Casing radiated	69	66	67	53	47	42	35	25
AHU-2								
Supply EC outlet	71.5	74	77.9	79.4	79.7	80.9	79	73.6
Return EC inlet	64.5	70	67.4	63.7	66.7	69.4	64.1	56.6
SPL at 1m	34.7	36.2	46.8	48.1	53.4	53.5	44.5	35.0
AHU-3								
Supply EC outlet	70.3	70	75.3	76.3	78.3	76.5	76.5	69.7
Return EC inlet	60.9	66.7	64.3	63.5	65	62.7	62	52.8
SPL at 1m	32.3	32.4	45.6	47.2	51.3	48.6	40.0	30.3
AHU-4								
Supply EC outlet	67.8	71.5	73.5	75.1	76.9	74.6	73.7	67.2
Return EC inlet	61.8	69.5	64.2	62.8	63.5	61.4	58.6	51.4
SPL at 1m	32.1	34.9	44.1	46.1	49.8	46.9	36.9	28.1
AHU-5								
Supply EC outlet	67.8	71.5	73.5	75.1	76.9	74.6	73.7	67.2
Return EC inlet	61.8	69.5	64.2	62.8	63.5	61.4	58.6	51.4
SPL at 1m	32.1	34.9	44.1	46.1	49.8	46.9	36.9	28.1
AHU-6								
Supply EC outlet	67.8	71.5	73.5	75.1	76.9	74.6	73.7	67.2
Return EC inlet	61.8	69.5	64.2	62.8	63.5	61.4	58.6	51.4
SPL at 1m	32.1	34.9	44.1	46.1	49.8	46.9	36.9	28.1
AHU-7								
Supply EC outlet	70.8	78.7	76.4	80.2	79.4	77.6	75.6	69.9
Return EC inlet	58.1	69.1	67.6	66.7	66.9	66	69.8	59
SPL at 1m	33.1	41.1	46.2	47.4	53.2	49.9	41.7	31.1

- B. In the event the sound power level specifications is exceeded by the submitted product, it shall be the option of the contractor, if approved in advance by the Architect and Mechanical Engineer, to provide additional sound traps or other sound attenuation devices (e.g. plenums, duct liner) to supplement the specified design in order to comply with the sound power level specification. The cost for the additional noise control shall be borne by the contractor. Calculations shall be provided by the contractor which substantiate that the sound power levels produced by the substituted equipment and any required sound attenuation devices do not exceed the specified sound power levels.

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

**END OF SECTION 23 74 15**

## SECTION 26 00 10 - BASIC ELECTRICAL REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Provisions of Division 01 apply to this section.
- B. This Section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26. It expands and supplements the requirements specified in sections of Division 1.
- C. Definitions, guarantees, submittals, clean-up, "As-Built" and all other applicable requirements of and Division 1 apply to the work of this section.
- D. Related Sections:
  - 1. Division 31: Earthwork
  - 2. Section 033000: Cast-In-Place Concrete
  - 3. Section 099100: Painting
  - 4. Division 23: Mechanical

#### 1.2 BASIC ELECTRICAL REQUIREMENTS

- A. Quality Assurance:
  - 1. Workers possessing the skills and experience obtained in performing work of similar scope and complexity shall perform the Work of this Division.
  - 2. Refer to other sections of the Specifications for other qualification requirements.
- B. Drawings and Specifications Coordination:
  - 1. For purposes of clearness and legibility, Drawings are essentially diagrammatic and the size and location of equipment is indicated to scale whenever possible. Verify conditions, dimensions, indicated equipment sizes, and manufacturer's data and information as necessary to install the Work of this Division. Coordinate location and layout with other Work.
  - 2. Verify final locations for rough-ins with field measurements and with the requirements of the equipment to be connected.
  - 3. Drawings indicate required size and points of termination of conduits, number and size of conductors, and diagrammatic routing of conduit. Install conduits with minimum number of bends to conform to structure, avoid obstructions, preserve headroom, keep openings and passageways clear, and comply with applicable code requirements.
  - 4. Routing of conduits may be changed provided that the length of any conduit run is not increased more than 10 percent of length indicated on the Drawings.

5. Outlet locations shall be coordinated with architectural elements prior to start of construction. Locations indicated on the Drawings may be distorted for clarity.
6. Coordinate electrical equipment and materials installation with building components and the Work of other trades.
7. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
8. Coordinate connection of electrical systems with existing underground utilities and services.

C. Terminology:

1. Signal Systems: Applies to clock, bell, fire alarm, annunciator, sound, public address, buzzer, telephone, television, inter-communication, elevator access controls, lighting control systems and security systems.
2. Low Voltage: Applies to signal systems operating at 120 volts and less, and power systems operating at less than 600 volts. Medium voltage: Applies to power systems operating at more than 600 volts.
3. UL: Underwriter's Laboratories Inc, Nationally Recognized Testing Laboratory (NRTL), or equal.

D. Regulations: Work shall comply with the requirements of authorities having jurisdiction and the California Electrical and Building Codes. Material shall conform to regulations of the National Board of Fire Underwriters for electrical wiring and apparatus. Materials shall be new and listed by UL, or another NRTL.

E. Structural Considerations for Conduit Routing:

1. Where conduits pass through or interfere with any structural member, or where notching, boring or cutting of the structure is necessary, or where special openings are required through walls, floors, footings, or other buildings elements, conform to CBC, Part 2, Title 24, Section 1906 A 3 for conduits and pipes embedded in concrete and Section 2320 A 11.10 for notches and bored holes in wood; for steel, as detailed on the structural steel Shop Drawings.
2. Where a concrete encasement for underground conduit abuts a foundation wall or underground structure which the conduits enter, encasement shall rest on a haunch integral with wall or structure, or shall extend down to footing projection, if any, or shall be doweled into structure unless otherwise indicated. Underground structures shall include maintenance holes; pull boxes, vaults, and buildings.
3. Holes required for conduit entrances into speaker poles, floodlight poles or other poles, shall be drilled with the conduit nipple or coupling welded to poles. Welds shall be provided by the electric arc process and shall be continuous around nipple or coupling.

F. Electrically Operated Equipment and Appliances:

1. Furnished Equipment and Appliances:
  - a. Work shall include furnishing and installing wiring enclosures for, and the complete connection of electrically operated equipment and appliances and electrical control devices which are specified to be furnished and installed in this

or other sections of the Specifications, wiring enclosures shall be concealed except where exposed Work is indicated on the Drawings.

- b. Connections shall be provided as necessary to install equipment ready for use. Equipment shall be tested for proper operation and, if motorized, for proper rotation. If outlets are of incorrect electrical characteristics or any specified equipment fails to operate properly, repair and/or replace the outlet and/or equipment.

2. Equipment and Appliances Furnished by Others:

- a. Equipment and appliances indicated on Drawings as "not in contract" (NIC), "furnished by others," or "furnished by the Owner," will be provided. Required electrical connections shall be performed for such equipment and appliances. Motorized equipment will be furnished factory-wired to a control panel or junction box unless otherwise indicated. Appliances will be furnished equipped with portable cord and cap. Provide disconnect switches where required.
- b. Connections to equipment furnished under this Division shall be part of the Work of this section. Work shall include internal wiring, installation, connection and adjustment of bolted drive motors in which the motor is supplied as a separate unit, and connections only for equipment furnished with factory installed internal wiring, except as further limited by Drawings and this Specification. Work shall include furnishing and installing suitable outlets, disconnecting devices, starters, push-button stations, selector switches, conduit, junction boxes, and wiring necessary for a complete electrical installation. Work shall also include furnishing and installing conduit and boxes for HVAC control systems with 120V, single phase circuit from nearest electrical panel, furnished under Division 15. Devices and equipment furnished shall be of same type used elsewhere on the Work or as specified.
- c. Electrical equipment furnished under other sections, for installation and connection under Work of this section, will be delivered to the Project site ready for installation.
- d. Mechanical equipment furnished under other sections, and requiring electrical connection under this section, will be set in place as part of the Work of the section furnishing such equipment unless noted otherwise.
- e. Suitability and condition of equipment furnished under other sections shall be determined in advance of installation. Immediate notice of damage, unsuitability, or lack of parts shall be given to the entity providing such equipment.

G. Protection of Materials:

1. Protect materials and equipment from damage and provide adequate and proper storage facilities during progress of the Work. Damaged materials and/or equipment shall be replaced.

H. Cleaning:

1. Exposed parts of Work shall be left in a neat, clean, usable condition. Finished painted surfaces shall be unblemished and metal surfaces shall be polished.
2. Thoroughly clean parts of apparatus and equipment. Exposed parts to be painted shall be thoroughly cleaned of cement, plaster, and other materials. Remove grease and oil spots

with solvent. Such surfaces shall be wiped and corners and cracks scraped out. Exposed rough metal shall be smooth, free of sharp edges, carefully steel brushed to remove rust and other spots, and left in proper condition to receive finish painting.

3. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

### **1.3 WARRANTIES**

- A. Provide one year warranty on all work performed, unless noted otherwise in specific sections.

### **1.4 DISCREPANCIES**

- A. Where a conflict in requirements occurs between the specifications and drawings, or in the specifications or on the drawings, and a resolution is not obtained from the Engineer before the bidding date, the more expensive alternate will become the contractual requirement.
- B. Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the work but they shall be performed as if fully and correctly set forth and described in the drawings and specifications.
- C. The Contractor shall check all drawings furnished him immediately upon their receipt and shall promptly notify the Engineer of any discrepancies. Figures marked on drawings shall in general be followed in preference to scale measurements. Large scale drawings shall in general govern small scale drawings. The Contractor shall compare all drawings and verify the figures before laying out the work and will be responsible for any errors which might have been avoided thereby.

### **1.5 SUBMITTALS**

- A. Submit shop drawings, manufacturer's data certificates for equipment, materials and finish, and pertinent details for each system where specified in each individual section, and obtain approval before procurement, fabrication, or delivery of the items to the job site. Partial submittals are not acceptable and will be returned without review. Include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable technical society publication references, and other information necessary to establish contract compliance of each item the Contractor proposes to furnish. Photographs of existing installations and data submitted in lieu of catalog data are not acceptable and will be returned without approval. Contractor shall be responsible for reviewing and certifying submittals as conforming to the drawings and specifications prior to submittal and shall verify conformance of equipment as delivered with final shop submittals, specifications and plans. Contractor shall report to Engineer any deviations prior to initiation of construction. Contractor is responsible for promptly reporting to Architect any news of late equipment delivery which is likely or certain to delay installation.
  1. Submit shop drawings and product data grouped and referenced by the technical Section numbers. Products must be highlighted on the product data sheets.

2. Submittal/shop drawing shall consist of cover sheet with specification number and the submitted products within the submittal shall be highlighted. Submittals shall be grouped per the related specification number.
3. Proposed Products List: Include Products as required by the individual section in this Division.
4. The Contractor shall be responsible for all equipment ordered and/or installed prior to receipt of shop drawings returned from the Engineer bearing the electrical engineer's stamp of "reviewed". All corrections or modifications to the equipment as noted on the shop drawings shall be performed and equipment removed from the job site when required by the Engineer, without additional compensation.
5. Shop Drawings: Drawings shall be a minimum of 8.5 inches by 11 inches in size with a minimum scale of 1/8-inch per foot, except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, duct work, and other items that must be shown to assure a coordinated installation. In wiring diagrams, identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. If equipment is disapproved, revise drawings to show acceptable equipment and resubmit.
6. Manufacturer's Data: For each manufactured item, provide current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves if applicable, and catalog cuts.
7. Standard Compliance: When materials or equipment provided by the Contractor must conform to the standards of organizations such as American National Standards Institute (ANSI) or Underwriters' Laboratories (UL), submit proof of such conformance to the Engineer for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified. In lieu of the label or listing, submit a certificate from an independent testing organization, which is competent to perform acceptance testing and is approved by the Engineer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard.
8. Certified Test Reports: Before delivery of materials and equipment, certified copies of all test reports specified in individual sections shall be submitted for approval.
9. Certificates of Compliance or Conformance: Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this contract. Pre-printed certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; or "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Manufacturer shall use Form 260010-A for equipment installation certification. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance or conformance.

## **1.6 GUARANTEE**

- A. Except as may be specified under other sections in the Specifications, guarantee all equipment furnished under the Specifications for a period of one year from date of project acceptance against defective workmanship and material and improper installation. Upon notification of failure, correct deficiency immediately and without cost to the Owner.
- B. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the Owner for their service agency as directed. Furnish manufacturer's warranties for all equipment furnished under this project.

## **1.7 MANUFACTURER'S RECOMMENDATIONS**

- A. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

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

## **PART 3 - EXECUTION**

### **3.1 GENERAL REQUIREMENTS**

- A. Advise the IOR before starting the Work of this Division.
- B. Exposed conduits shall be painted to match the surfaces adjacent to installation.
- C. Salvaged materials removed from buildings shall be removed from the Project site as required by the OAR.
- D. Trenches outside of barricade limits shall be backfilled and paved within 24 hours after being inspected by the IOR. Provide traffic plates during the time that trenches are open in traffic areas and in areas accessible to students and staff.
- E. Where existing structural walls are cored for new conduit runs, separation between cored holes shall be 3 inches edge to edge from new or existing holes, unless otherwise required by the Architect. All coring to be laid out and reviewed by Architect prior to drilling. Contractor to verify location of structural steel, rebar, stress cabling or similar prior to lay out.
- F. Electrical equipment shall be braced and anchored for California Zone 4 seismic requirements, or as otherwise indicated on the Drawings.

### **3.2 WORK RESPONSIBILITIES**

- A. The drawings indicate diagrammatically the desired locations or arrangement of conduit runs, outlets, equipment, etc., and are to be followed as closely as possible. Proper judgement must be exercised in executing the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference with structural conditions. The contractor is responsible for the correct placing of his work and the proper location and connection of his work in relation to the work of other trades. Advise appropriate trade as to locations of access panels.
- B. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes shall be made without extra cost, providing the change is ordered before the conduit runs, etc. and work directly connected to same is installed and no extra materials are required.
- C. Where equipment is furnished by others, verify dimensions and the correct locations of this equipment before proceeding with the roughing-in of connections.
- D. Do not install light outlets or fixtures until mechanical piping and duct work is installed; then lights shall be installed in locations best suited for equipment arrangement or as directed by the Engineer.
- E. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with any work, carefully check and verify all dimensions, sizes, etc. with the shop drawings to see that the equipment will fit into the spaces provided without violation of applicable codes.
- F. Should any changes to the work indicated on the drawings or described in the specifications be necessary in order to comply with the above requirements, notify the Engineer immediately and cease work on all parts of the contract which are affected until approval for any required modifications to the construction has been obtained from the Engineer.
- G. Be responsible for any cooperative work which must be altered due to lack of proper supervision or failure to make proper provisions in time. Such changes shall be under direction of the Engineer and shall be made to his satisfaction.
- H. Perform all work with competent and skilled personnel.
- I. All work, including aesthetic as well as electrical and mechanical aspects of the work, shall be of the highest quality consistent with the best practices of the trade.
- J. Replace or repair, without additional compensation, and any work which, in the opinion of the Engineer, does not comply with these requirements.

### **3.3 OPERATION AND MAINTENANCE MANUAL**

- A. Provide operation and maintenance manual of all equipment and lighting fixtures furnished on this project



### **3.4 POSTED OPERATING INSTRUCTIONS:**

- A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation and maintenance personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions as directed. Attach or post operating instructions adjacent to each principal system and equipment including startup, proper adjustment, operating, lubrication, shutdown, safety precautions, procedure in the event of equipment failure, and other items of instruction as recommended by the manufacturer of each system or equipment. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

### **3.5 MANUFACTURER'S RECOMMENDATIONS:**

- A. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

### **3.6 DELIVERY STORAGE AND HANDLING**

- A. Deliver products to project site with proper identification, which shall include names, model numbers, types, grades, compliance labels, and similar information needed for District identification; all products and materials shall be adequately packaged and protected to prevent damage during shipment, storage, and handling.
- B. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion.

### **3.7 CUTTING AND PATCHING**

- A. Cutting and patching of electrical equipment, components, and materials shall include the removal and legal disposal of selected materials, components, and equipment.
- B. Do not endanger or damage installed Work through procedures and processes of cutting and patching.
- C. Repair or restore other work, or surfaces damaged as a result of the work performed under this contract.

### **3.8 CLEANUP**

- A. Remove rubbish, debris and waste materials and legally dispose off the Project site.

- B. Remove equipment and implements of service, and leave entire work area neat and clean, to the satisfaction of the Owner Authorized Representative.

### **3.9 PROTECTION**

- A. Protect the Work of this section until Substantial Completion.

**END OF SECTION 26 00 10**

**P2S Inc.**  
005.2882.000

January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

## SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Low-voltage wire, splices, terminations and installation.

### PART 2 - PRODUCTS

#### 2.1 WIRES

- A. A.Wires shall be single conductor type THHN or THWN insulated with polyvinyl chloride and covered with a protective sheath of nylon, rated at 600 volts. Wires may be operated at 90 degrees C. maximum continuous conductor temperature in dry locations, and 75 degrees C. in wet locations and shall be listed by UL Standard 83 for thermoplastic insulated wires, listed by Underwriter's Laboratories (UL) for installation in accordance with Article 310 of the California Electrical Code (CEC). Conductors shall be solid copper for 12 AWG and smaller conductors, and stranded copper for 10 AWG and larger conductors. Conductors shall be insulated with PVC and sheathed with nylon. Wires shall be identified by surface markings indicating manufacturer's identification, conductor size and metal, voltage rating, UL symbol, type designations and optional rating. Indentations for lettering is not permitted. Wires shall be tested in accordance with the requirements of UL standard for types THWN, or THHN.
- B. B.Conductors shall be solid Class B or stranded Class C, annealed uncoated copper in accordance with UL standards, or another Nationally Recognized Testing Laboratory (NRTL).

#### 2.2 STANDARDS

- A. A.THWN/THHN wires shall comply with the following standards:
  - 1. UL 83 for thermoplastic insulated wires.
  - 2. UL 1063 for machine tool wires and cables.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Wires shall not be installed until debris and moisture is removed from conduits, boxes, and cabinets. Wires stored at site shall be protected from physical damage until they are installed and walls are completed.

- B. Wire-pulling compounds furnished as lubricants for installation of conductors in raceways shall be compounds approved and listed by UL, NRTL, or equal. Oil, grease, graphite, or similar substances are not permitted. Pulling of 2 AWG or larger conductors shall be performed with a cable pull machine. Any runs shorter than 50 feet are exempt. When pulling conductors, do not exceed manufacturer's recommended values
- C. The IOR will observe installation of feeder cables. Notify the IOR not less than 2 working days in advance of the proposed time of feeder installation.
- D. At outlets for light, power, and signal equipment, pigtail splices with 8-inch circuit conductor leads for connection to fixtures, equipment, and devices.
- E. Pressure cable connectors, pre-insulated Scotchlok, 3M, or equal, Y, R or B spring-loaded twist-on type, may be furnished in splicing number 8 AWG or smaller wires for wiring systems; except public address and telephone systems.
- F. All Joints, splices, taps, and connections to switchboard neutral, bonding or grounding conductors, conductors to ground busses, and transformer connections for wires 6 gauge and larger shall be performed with high-pressure cable connectors approved for installation with copper conductors. Connectors shall be insulated with heavy wall heat shrink WCSM, or cold-applied roll-on sleeve RVS. Insulation level shall be a minimum of 600V and joints, splices, and taps shall be qualified to ANSI C 119.2, UL, NRTL, or equal listed mechanical pressure connections.
- G. Connections to any bussing and high-press cable connectors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade 5 machine screws secured with constant pressure-type locking devices.
- H. Connection of any bonding or grounding conductors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade 5 machine screws secured with constant pressure-type locking devices.
- I. Wire switchboards, panel cabinets, pull boxes, and other cabinets except public address, shall be neatly grouped and tied in bundles with nylon ties at 10-inch intervals. In switchboards, panels and terminal blocks, wires shall be fanned out to terminals. If bundles are longer than 24 inches, a maximum of 9 current carrying conductors may be bundled together.
- J. Install conductor lengths with a minimum length within the wiring space. Conductors must be long enough to reach the terminal location in a manner that avoids strain on the connecting lug.
- K. Maintain the conductor required bending radius.
- L. Neutral conductors larger than 6 gauge, which are not color identified throughout their entire length, shall be taped, painted white or natural gray, or taped white where they appear in switchboards, cabinet, gutters or pull boxes. Neutral conductors 6 gauge and smaller shall be white color identified throughout their entire length.
- M. Fire alarm wiring shall be continuous from terminal cabinets or from equipment to each device. Splices are not permitted between devices and/or terminal cabinets at junction and pull boxes. Wiring shall be terminated at terminal blocks or devices only.

- N. Wiring systems shall be free from short circuits and grounds, other than required grounds. Provide the services of an approved independent testing laboratory to test feeder insulation resistance. The tests to be performed are as follows:
1. With a megger insulation tester, perform the time-resistance method to test feeders and branch circuit wires. Tests must be conducted with wire disconnected at each end in order to test the wire itself. A second test must be conducted with the wire connected at each end and the circuit breakers or switches in the closed positions.
  2. Tests shall be performed in presence of the IOR.
  3. Insulation resistance shall not be less than 100 mega-ohms.

### 3.2 COLOR CODES

A. General Wiring:

1. Color code conductor insulation as follows:

SYSTEM VOLTAGE		
Conductor	208Y/120	480Y/277
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White or Gray	White with colored stripe

Neutrals shall be colored-distinguished if circuits of two voltage systems are used in the same raceway.

2. For phase and neutral conductors 6 gauge or larger, permanent plastic-colored tape may be furnished to mark conductor end instead of coded insulation. Tape shall cover not less than 2 inches of conductor insulation within enclosure.

B. Signal Systems: Wires for signal systems shall be color-coded and installed under observation of the IOR. Except where otherwise specified, color-coding shall be as follows:

<u>SYSTEM</u>	<u>COLOR CODE</u>
Initiating Devices (Non-Addressable)	Red (+) and Black (-)
Fire Alarm Horns	Pink (+) and Gray (-)
Fire Alarm Strobes	Orange (+) and Blue (-)
Un-Interruptible 24 Volt Power (Annunciator, Water Flow, and Audible Device)	Yellow (+) and White (-) Note: A single white wire may be common to both
Interruptible 24 Volt Power (4 wire smoke detectors, duct detectors)	Brown (+) and White (-) Note: A single white wire may be common to both
Switch-Leg Sprinkler Bell (Between water flow and audible device)	Violet (+) and White (-)

Door Holding Magnets (Non Power Limited)	Black (+) and White (-)
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**3.3 FEEDER IDENTIFICATION**

- A. A. Feeder wires and cables shall be identified at each point the conduit run is broken by a cabinet, box, gutter, etc. Where terminal ends are available, identification shall be by means of heat shrink wire markers, which provide terminal strain relief. Markers shall be Brady Perma-Sleeve, or equal. Identification in other areas shall be by means of wrap-around tape markers Brady Perma-Code or equal. Markers shall include feeder designation, size, and description.

**3.4 TAPE AND SPLICE KITS**

- A. A. Splices, joints, and connectors joining conductors in dry and wet locations shall be covered with insulation equivalent to that provided on conductors. Free ends of conductors connected to energized sources shall be taped. Voids in irregular connectors shall be filled with insulating compound before taping. Thermoplastic insulating tape approved by UL, NRTL, or equal for installation as sole insulation of splices shall be furnished and shall be installed according to manufacturer's printed specifications.

**3.5 PROTECTION**

- A. A. Protect the Work of this section until Substantial Completion.

**3.6 CLEANUP**

- A. A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

**END OF SECTION 26 05 19**

## SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Provide and install grounding system as indicated or required.

#### 1.2 SYSTEM DESCRIPTION

- A. Metallic objects on the Project site that enclose electrical conductors, or that are likely to be energized by electrical currents, shall be effectively grounded.
- B. Metal equipment parts, such as enclosures, raceways, and equipment grounding conductors, and earth grounding electrodes shall be solidly joined together into a continuous electrically conductive system.
- C. Metallic systems shall be effectively bonded to the main grounding electrode system.
- D. A separately derived AC source shall be grounded to the equipment grounding conductor, and to separate "made" electrode of building grounding electrode system.
- E. Electrical continuity to ground metal raceways and enclosures, isolated from equipment ground by installation of non-metallic conduit or fittings, shall be provided by a green insulated grounding conductor of required size within each raceway connected to isolated metallic raceways, or enclosures at each end. Each flexible conduit over 6 feet in length shall be provided with a green insulated grounding conductor of required size.
- F. Cold water, or other utility piping systems, shall not be utilized as grounding electrodes due to the installation of insulating couplings and non-metallic pipe in such installations. Grounding electrodes shall be "made" electrodes specified as follows:
  - 1. A dedicated "made" electrode, fabricated of at least 20 feet of galvanized 1/2 inch diameter rebar encased by at least 2 inches of concrete, and placed next to the bottom of a concrete foundation, or footing in direct contact with earth. A welded extended portion shall surface at the location of the common grounding electrode bus bar and be extended by a 3/0 CAD welded bare copper cable, or be CAD welded directly to the bus. The CAD weld shall be at least 4 inches above finished floor in a dry location. The main grounding electrode and associated grounding conductors shall be in an enclosure and in conduit.
  - 2. Grounding electrodes as specified hereafter in this section.
  - 3. Concrete enclosed electrode, fabricated of at least 20 feet of No. 2 AWG, minimum size, bare copper conductor, encased by at least 2 inches of concrete, located within or near bottom of a concrete foundation, or footing, which is in direct contact with earth. Footing rebar shall be connected to copper wire with approved connectors. An external electrode,



as specified hereafter or as required by the CEC, shall be installed and connected to foundation or footing rebar.

- G. Non-current carrying metal parts of high-voltage equipment enclosures, signal and power conduits, switchboard and panelboard enclosures, motor frames, equipment cabinets, and metal frames of buildings shall be permanently and effectively grounded. Provide a CEC sized grounding conductor in every raceway.
- H. Metallic or semi-conducting shields and lead sheaths of cables operating at high voltage, shall be permanently and effectively grounded at each splice and termination.
- I. Neutral of service conductors shall be grounded as follows:
  - 1. Neutral shall be grounded at only one point within the Project site for that particular service. Preferable location of grounding point shall be at the service switchboard, or main switch.
  - 2. Equipment and conduit grounding conductors shall be bonded to that grounding point.
  - 3. If other buildings or structures on the Project site are served from a switchboard or panelboard in another building, power supply is classified as a feeder and not as a service.
  - 4. Equipment grounding conductor is installed from switchboard to each individual building. At building, grounding conductor is bonded with power equipment enclosures, metal frames of building, etc., to “made” electrode for that building.
  - 5. Feeder neutrals shall be bonded at service entrance point only, neutrals of separately derived systems shall be bonded at the source only.
- J. If there is a distribution transformer at a building the secondary neutral conductor shall be grounded to “made” electrode serving the building.
- K. Within every building, the main switchboard or panelboard, shall be bonded to the cold water line. Metallic piping systems such as gas, fire sprinkler, or other systems shall be bonded to the cold water line.

### **1.3 SUBMITTALS**

- A. Provide in accordance with Division 01.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Furnished yard boxes shall be precast concrete and shall be approximately 14 inches wide by 19 inches long by 12 inches deep or larger, if necessary to obtain required clearances. Boxes shall be furnished with bolt-down, checkered, cast iron covers and cast iron frames cast into boxes. Yard boxes shall be Brooks 36, or equal.

- B. "Made" electrodes shall be copper-clad steel ground rods, minimum 3/4 inch diameter by 10 feet long.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Grounding electrodes shall be installed in the nearest suitable planting area, where not otherwise indicated on Drawings, and each electrode shall terminate within a concrete yard box installed flush with finish grade. In planting areas, finish elevation of concrete yard boxes shall be 2 inches above planting surfaces.
- B. If concrete enclosed electrode is provided, grounding wire shall be terminated to a suitable copper plate with grounding lugs and must be enclosed in a raceway or box..
- C. Grounding rods shall be driven to a depth of not less than 8 feet. Permanent ground enhancement material, as manufactured by Erico Electrical Products, or equal, shall be installed at each ground rod to improve grounding effectiveness. Install in accordance with manufacture's installation instructions.
- D. Grounding electrodes shall provide a resistance to ground of not more than 25 ohms.
- E. When installing grounding rods, if resistance to ground exceeds 25 ohms, 2 or more rods connected in parallel, or coupled together shall be provided to meet grounding resistance requirements.
- F. Ground rods shall be separated from one another by not less than 10 feet.
- G. Parallel grounding rods shall be connected together with recognized fittings and grounding conductors in galvanized rigid steel conduit, buried not less than 12 inches below finish grade.

#### **3.2 TESTING**

- A. Provide the services of an approved independent testing laboratory to test grounding resistance of "made" electrodes, ground rods, bonding of building steel, water pipes, gas pipes and other utility piping. Tests shall be performed as follows:
  - 1. Visually and mechanically examine ground system connections for completeness and adequacy.
  - 2. Perform fall of potential tests on each ground rod or ground electrode where suitable locations are available per IEEE Standard No. 81, Section 8.2.1.2. Where suitable locations are not available, measurements will be referenced to a known dead earth or reference ground.
  - 3. Perform the two point method test per IEEE No. 81, Section 8.2.1.1 to determine ground resistance between ground rod and building steel, and utility piping - such as water, gas and panelboard grounds. Metal railings at building entrances and at handicapped ramps shall also be tested.

**3.3 CLEANUP**

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

**END OF SECTION 26 05 26**

## SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
  - 1. Section 260548 "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

#### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of [five] <Insert number> times the applied force.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel slotted support systems.
  - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: **Signed and sealed by a qualified professional engineer.** Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze hangers. Include Product Data for components.
  - 2. Steel slotted channel systems. Include Product Data for components.
  - 3. Nonmetallic slotted channel systems. Include Product Data for components.
  - 4. Equipment supports.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

## 1.7 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

## 1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077100 Roof Specialties.

## PART 2 - PRODUCTS

### 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 2. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

- a. [Cooper B-Line, Inc.; a division of Cooper Industries.](#)
  - b. [ERICO International Corporation.](#)
  - c. [Thomas & Betts Corporation.](#)
  - d. [Unistrut; Tyco International, Ltd.](#)
3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  6. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches o.c., in at least 1 surface.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. [Cooper B-Line, Inc.; a division of Cooper Industries.](#)
    - b. [Fabco Plastics Wholesale Limited.](#)
    - c. [Seasafe, Inc.](#)
  2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
  3. Fitting and Accessory Materials: Same as channels and angles.
  4. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: 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 non-armored 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 malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, 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.

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1) Hilti Inc.
  - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
  - 3) MKT Fastening, LLC.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
    - 2) Empire Tool and Manufacturing Co., Inc.
    - 3) Hilti Inc.
    - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
    - 5) MKT Fastening, LLC.
  3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
  4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  6. Toggle Bolts: All-steel springhead type.
  7. Hanger Rods: Threaded steel.

## 2.2 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 055000 "Metal Fabrications" for steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by CEC 2016. Minimum rod size shall be 1/4 inch in diameter.

- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. 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, as permitted in 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 meet seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.



### **3.3 INSTALLATION OF FABRICATED METAL SUPPORTS**

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### **3.4 CONCRETE BASES**

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
  - 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 requirements in 099100 "Painting" 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 A 780.

**END OF SECTION 26 05 29**

## **SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 GENERAL REQUIREMENTS**

- A. All wiring shall be installed in concealed conduit unless indicated otherwise in these specifications. Surface raceways shall be used in exposed locations in finished areas where conduits cannot be concealed. All surface installation will require College approval.
- B. Separate conduit shall be used for the following wiring:
  - 1. Emergency Power System Wiring.
  - 2. Stand By Power System Wiring.
  - 3. Fire Alarm System.
  - 4. Public Address System.
  - 5. Security System.
  - 6. Telephone/Data Outlets (See Telecom/Data Section).
- C. Boxes shall include:
  - 1. Boxes
  - 2. Cabinets and Enclosures
  - 3. Safety Switches

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Rigid Steel Conduit: Provide standard weight steel that is hot-dipped galvanized, and sherardized both inside and out after threading, with threaded connectors and couplings. Electro galvanizing is not permitted. Intermediate Metal Conduit, IMC, will not be permitted.
- B. Rigid Steel Conduit Fittings: Fitting shall be zinc coated, ferrous metal and threaded type in accordance with ANSI C80.4.
- C. Electric Metallic Tubing (EMT): Provide tubing of high grade cold rolled steel electrically welded with exterior protective coating of hot galvanized zinc, applied by the electro galvanized process. Interior of surface coated with aluminum lacquer or enamel. Manufactured by Allied Tube and Conduit, Triangle, Republic, Torrance Tubing, Western, Wheatland or equal.
- D. EMT Fittings: Fitting shall be watertight, gland ring compression type (no set screw type), wrench tightened connectors and coupling. Indenture and Die Cast will not be acceptable. Manufactured by O-Z Gedney, Raco, Appleton, or Steel City.
- E. Aluminum Conduit: No aluminum conduits.

- F. Flexible Steel Conduit: Provide conduit manufactured from single strip, standard weight steel hot-dipped galvanized on all four sides prior to conduit fabrication or aluminum strips.
- G. Flexible Conduit Connectors and Couplings: Provide die cast fittings of the type that screw into the inside of the conduit with threaded edges at 90 degrees to the fitting body to insure a force fit. Binding screw type will not be acceptable. Manufactured by O-Z Gedney, T&B, Steel City or equal.
- H. Flexible Liquidtight Steel Conduit: Liquid-tight conduit shall be manufactured from single strip standard weight steel, hot dipped galvanized on all four sides prior to conduit fabrication, and shall be provided with an extruded polyvinyl chloride cover. Liquidtight conduit and fittings shall provide positive ground continuity. Include a separate ground conductor for each circuit. Manufacturer "Sealtite Flexible" Type "UA," "Flex-Seal Type "XL," or equal.
- I. Flexible Liquidtight Fittings: Fittings shall be malleable iron, zinc plated, with locknut and o ring seal and slim diameter with small turning radius. Manufactured by O-Z Gedney-4Q series, T&B- 5200 series or Appleton Flexible Fittings-ST series.
- J. Rigid Plastic Conduit: Provide heavy wall, virgin polyvinyl chloride Schedule 40 and Schedule 80 with solvent welded joints, conforming to Underwriters Laboratories, Inc. (UL 651) and ANSI C33.91 requirements, listed for exposed and direct burial application.
- K. Rigid PVC Fittings: fittings and cement shall be provided by same manufacturer. All joint shall be solvent welded in accordance with the manufacturer's recommendations.
- L. No conduit shall be smaller than 3/4-inch unless noted otherwise.
- M. Sleeves shall be zinc coated galvanized steel pipe or 16 gauge galvanized sheet metal.
- N. Sealant: Fire rated equal to wall or ceiling penetrated. Silicon foam Dow-Corning #2001, 3M, "Pensil #851," or approved equal. Sealant compound for exterior wall shall be moisture-resistant material made by 3M, GE, Dow-Corning or equal.
- O. Anchors not cast into concrete shall be expansion shield type, Phillips "Red Head," Hilti, or equal.
- P. Conduit seals shall be Crouse-Hinds Type "EYS" or EZS," Appleton Type "ESUF" or "ESUM," or approved equal, with sealing compound as recommended by the manufacturer for hazardous or refrigerated areas.
- Q. Expansion couplings shall be OZ Type "AX" or "DX," Crouse-Hinds Type "XJ" or "SD" or equal, complete with bonding jumper.
- R. Conduit unions shall be "Erickson" couplings manufactured by Thomas and Betts, Type 4-Series manufactured by O-Z/Gedney or equal.

## **2.2 MINIMUM SIZE:**

- A. Metal Conduit: 3/4 inch except 1/2 inch may be used for switch legs.

- B. Non metallic conduit: 1 inch.

### **2.3 RIGID STEEL CONDUIT AND FITTINGS:**

- A. Provide standard weight steel that is hot dipped galvanized including threads, with protective coating on inside and outside. Fittings shall be compression type steel insulated. Electro galvanizing is not permitted.

### **2.4 ELECTRIC METALLIC TUBING (EMT) AND FITTINGS:**

- A. Provide tubing of high grade steel with exterior coating of zinc, applied by electro galvanized process and enamel coating on inside. Fittings shall be watertight compression type, wrench tightened connectors and couplings.

### **2.5 FLEXIBLE STEEL CONDUIT AND FITTINGS:**

- A. Provide conduit formed from continuous length of spirally wound interlocked zinc-coated strip steel. Flexible aluminum and light weight steel conduit will not be permitted. Fittings shall be die cast type that screw into the inside of the conduit with threaded edges at 90 degrees to the fitting body to ensure a force fit. Maximum length shall be 6'.

### **2.6 FLEXIBLE LIQUID TIGHT STEEL CONDUIT AND FITTINGS:**

- A. Conduit shall be manufactured from single strip, flexible continuous interlocked, and double-wrapped steel; galvanized inside and outside; and shall be provided with an extruded polyvinyl chloride cover. Fittings shall provide positive ground continuity. Maximum length shall be 6'.

### **2.7 CONDUIT SLEEVES:**

- A. Sleeves shall be zinc coated galvanized steel pipe or 18 gauge galvanized sheet steel.

### **2.8 RIGID PLASTIC CONDUIT AND FITTINGS:**

- A. Provide heavy wall, virgin polyvinyl chloride (PVC) schedule 40 with self extinguishing additive conforming to UL requirements.

### **2.9 OUTLET BOXES**

- A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1, galvanized steel.
  - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.
- B. Nonmetallic Outlet Boxes: ANSI/NEMA OS 2.

- C. Cast Boxes: NEMA FB 1, Type FD, cast ferrous alloy. Provide gasketed cover and threaded hubs by box manufacturer.

**2.10 CABINETS: UL 50.**

- A. Cabinets for same type of use shall be the product of a single manufacturer.
- B. Construct of cold-rolled drawing quality steel, with metal gages and construction methods conforming to National Electrical Code requirements, and Underwriters Laboratories' standards. Provide 12 gauge G-90 grade galvanized steel minimum, unless otherwise noted.
- C. Finish doors, trims, and back boxes for surface-mounted cabinets in finished areas by applying a rust-resistant treatment, prime coat, and a final coat of manufacturer's standard enamel or lacquer finish. Galvanize all other sheet metal components of cabinets including back boxes for flush cabinets, excepting non-ferrous metal parts, or steel parts provided with cadmium plating or equivalent protective plating.
- D. Equip doors with concealed or semi-concealed hinges and with flush or semi-flush spring catch type flush cylinder locks. Key cabinet doors of similar use alike, and provide two keys with each lock.
- E. Equip cabinets for use with telephone, alarm or signal systems with a 0.5" thick plywood backboard. Equip cabinets with terminal strips where so specified. Equip cabinets with nameplates.
- F. Surface cabinets shall be furnished without knockouts. Punch or drill required openings during installation. Equip flush back boxes with manufacturer's standard pattern of knockouts.
- G. Equip cabinet doors exceeding 40" in height with vertical bolt three point locking mechanisms.
- H. Acceptable manufacturers: Products of the following manufacturers are acceptable.
  - 1. Cabinets for general use: Hoffman Engineering Co., Square D, or Columbia Manufacturing Co.
  - 2. Cabinets for systems and/or products, use cabinets furnished by manufacturer with system or product. Where system or product cabinets do not comply with these Specifications, submit cabinet shop drawings, indicating deviations, and obtain approval for their use.

**2.11 JUNCTION BOXES AND PULL BOXES: UL 50.**

- A. Provide pull and junction boxes of Code gauge steel sized as indicated or required. Provide 16 gauge steel minimum, unless otherwise noted. Indoor enclosures shall conform to NEMA ICS 6 for the Type 12, unless otherwise noted.
- B. Size junction and pull boxes to not less than minimum Code requirements. Increase size above Code requirements where necessary to provide space for pulling, racking or splicing enclosed conductors, or where specified or indicated dimensions exceed Code requirements.

- C. Fabricate sheet metal junction and pull boxes of galvanized, Code gauge, sheet steel. Include angle iron framing where required for rigidity. Boxes shall not deflect or deform visibly when covers are removed after conduit and conductors are installed, and any deflection occurring shall not prevent the easy installation and removal of cover attachment screws.
- D. Do not use single covers for junction and pull boxes having cover length or width dimension exceeding three feet unless so specified, indicated, or approved. Sectionalize covers that exceed three feet in either dimension into two or more sections.
- E. Equip metal junction and pull boxes exposed to weather (and not installed in or below grade) with raintight or weatherproof removable covers. Enclosures shall conform to NEMA ICS 6 for the Type 4, unless otherwise noted. Rain tight or weatherproof boxes shall be used threaded watertight hubs for top or side entry and may use knockout for bottom entry only. For exterior pull boxes, use a minimum of 14 gage galvanized G-90 grade sheet steel.
- F. Use concrete junction and pull boxes for exterior underground conduit unless otherwise specified or indicated. Use steel plate or cast iron covers and rims in no traffic areas, and cast iron covers and rims designed for AASHTO Class H20 wheel loading wherever vehicular traffic will occur.
- G. For interior junction and pull boxes located in concrete floors, and 24" square or smaller, use cast iron boxes with integral cast tapped conduit hubs, and having recessed cover flush in the box trim placing all elements of the face of the box flush in the plane of the surrounding floor. Equip boxes with watertight covers where so indicated.
- H. For interior pull boxes located in concrete floors and larger than 24" square, use precast concrete boxes or form these boxes at the job site. Equip with angle iron cover rim, and with reinforced steel cover plate set flush with the finish floor plans. Specific plan details shall supersede these general requirements.
- I. Equip grade level exterior pull boxes with a sump, and with knockouts for conduit on sides and ends. Coordinate requirements for conduit openings with underground conduit requirements. Identify the covers of exterior grade level junction and pull boxes with the work "ELECTRIC" cast into or otherwise permanently inscribed in the metal of the cover. Equip exterior grade level pull boxes with pull irons where so indicated.
- J. Equip surface sheet metal junction and pull boxes with covers aligning with the sides of the boxes and equip flush boxes with covers extending 3/4" all around the perimeter of the back box. Provide sufficient cover attachment screws to ensure that box covers will contact the surface of the box for the entire perimeter of the enclosure. Use galvanized or cadmium-plated screws, or brass screws to attach covers to boxes.
- K. Use brass screws to attach junction and pull box covers to interior floor boxes or to boxes located where moisture may be present.
- L. Acceptable manufacturers:
  - 1. Sheet steel junction and pull boxes: Columbia Electric Co., Hoffman Engineering Co., Pico Metal Products Co.

2. Cast iron junction and pull boxes: O.Z. Electric Manufacturing Co., Alhambra Foundry Co., Ltd., Crouse Hinds Co.
3. Concrete junction and pull boxes: Brooks Products Inc., Quickset Co.

## **2.12 SAFETY SWITCHES**

- A. NEMA KS 1. Switches serving as motor-disconnect shall be horsepower rated. Provide heavy-duty type switches. Fused switches shall utilize Class R fuseholders and fuses unless indicated otherwise. Unless otherwise indicated, provide indoor switches in NEMA Type 12 enclosure, per NEMA ICS 6. Provide outdoor switches in NEMA Type 4 enclosure, per NEMA ICS 6.
- B. Unless otherwise indicated or required, use only unfused type for motor or equipment disconnects. Provide switches for the number of poles and the voltage, current and horsepower ratings as required.
- C. Provide each switch with laminated plastic nameplate indicating panel designation and circuit number of the feeder and equipment controlled.

## **2.13 WIRE CONNECTORS AND TERMINALS: For use with copper conductors. UL 486A.**

## **2.14 INSULATING TAPES: UL 510.**

## **2.15 NAMEPLATES: Provide as specified in Section 260553, "Identification for Electrical Systems."**

# **PART 3 - EXECUTION**

## **3.1 CONDUIT**

- A. Size of conduit shall be as indicated on the drawings but not less than that required by California Electrical Code.
- B. Rigid Steel Conduit:
  1. Use permitted for following applications only:
    - a. All outdoor locations including locations exposed to outside air.
    - b. Feeders.
    - c. Electrical and mechanical equipment rooms.
    - d. Indoor exposed locations where subject to mechanical damage and installed within 8 feet above finished floor.
    - e. Recessed in concrete walls and columns.
    - f. All other locations permitted by code.
- C. Electric Metallic Tubing (EMT):

1. Use permitted for following applications only:
  - a. For all sizes up to 4 inches maximum.
  - b. In dry locations as in stud-wall partitions and in suspended ceiling spaces only. Do not use outdoors.

**D. Flexible Metal Conduit:**

1. Use permitted for following applications only:
  - a. Final connections to vibrating or noise-generating equipment including transformers.
  - b. Final connections to light fixtures in lay-in type accessible ceiling construction.

**E. Liquid Tight Flexible Conduit:**

1. Use permitted for following applications only:
  - a. For final connections to vibrating or noise-generating equipment in damp and wet locations in mechanical rooms.
  - b. For other power and control equipment requiring adjustments or removal for service in damp and wet locations.

**F. Rigid Plastic Conduit PVC Schedule 40:**

1. Use permitted for underground wiring only.
2. Make all fittings in plastic conduit watertight with solvent-weld cement recommended by conduit manufacturer and specifically manufactured for the purpose. Use a spring mandrel as required to assure full inside diameter at all bends.
3. Minimum size shall be 1 inch.

**G. Conduit Placement:**

1. Support conduits 1-inch and larger with pipe clamps either suspended from structural slabs with a rod at least 3/8 -inch diameter with adjustable pipe ring, or mounted on wall from channel supports. Attach to concrete with drilled anchors. Where two or more conduits 1-1/2-inch and larger are suspended from ceiling, use trapeze type hanger suspended from rods.
2. Where rigid metal conduits and electrical metallic tubing are supported from Building members, supports shall be installed as follows:

Conduit Sizes:

3/4" to 1-1/4"

Within 18" of each outlet inclusive: and on either side of couplings and fittings and at a spacing not to exceed 8 feet;

1-1/2" and larger:

Within 3 feet of each junction or pullbox and terminal cabinet and at a spacing not to exceed 8 feet.



3. When rigid conduits are supported from trapezes, the supports shall be spaced not more than 8 feet apart.
  4. Conduit trapezes shall consist of suitable Unistrut or Kindorf fittings, or equal, in accordance with the manufacturer's printed recommendation.
- H. Provide independent support for all conduit rising from floor for motor connection if over 18 inches above floor. Do not support to motor, to ductwork or mechanical equipment.
- I. Keep bends and offsets in conduit runs to an absolute minimum. Replace all deformed, flattened or kinked conduit, at Contractor's expense.
- J. Ream the ends of all conduits. Conduits shall not be installed in the slab.
- K. Paint fire alarm conduits with a 1-inch wide red band every 5 feet of run. Separate conduits to be provided for fire alarm system.
- L. Install conduit seals on all conduit entering or leaving low temperature area (65 degrees fahrenheit or less) hazardous areas, refrigerated rooms and clean rooms.
- M. Seal all conduit from exterior outlets at first interior junction box to prevent moisture from entering the building through the conduit.
- N. All exposed conduits shall be installed parallel to and perpendicular to the building structure.
- O. Vertical Supports:
1. Supports shall be provided in strict compliance with National Electrical Code.
- P. Where bends or risers from underground PVC Schedule 40 conduit terminate above grade or floor or in areas where subject to physical damage during or after construction, use rigid steel factory ells. If additional riser or nipple is required, they also shall be rigid steel. The rigid steel ells and risers shall be taped with Slipknot #100 pipe wrapping tape, or equal (no know equal).
- Q. Pull Wires. Provide a 1/8" size polypropylene pull wire in all empty conduits, including those for signal and telephone systems. Pull cords in telephone/data service conduits (4" and larger) shall be 3/16" size. Identify conduits at exposed ends with tags. Tags shall identify location of other end of conduit. The pull wires shall be left with more than 5 feet in length at both ends for future use.
- R. Joints and Connections. Cut conduit squarely and ream ends to remove burrs. Close open ends of conduits, unless in a closed box or cabinet, with approved conduit caps or closures as soon as installed and keep closed until ready to pull in conductors.
- S. Steel conduit must be clear from contact with building reinforcing steel or other conductors in the building. Each conduit should run no more than two 90 degree bends. If more than two 90 degree bends are necessary, insert an accessible pull-box in the run. Terminate underground conduit inside the building, 2" above the floor below a backboard, or flush with the inside of a cabinet. Terminate overhead conduit 2 feet below floor slab, or flush with the inside of a cabinet.

- T. Where conduits pass through exterior concrete or masonry walls below grade, or through floor slab on fill below grade, make entrance watertight. Install pipe sleeves in concrete with 1/2" minimum clearance around conduit and caulk with oakum and mastic, or use gland type conduit entrance seal.
- U. Underground conduits, which terminate inside building below grade, or which slope so that water might flow into building, shall be sealed at termination after installation of conductors. Install plugs or caps on all spare (empty) conduits.
- V. Do not install conduits in any isolated floor slab. Where it is necessary to cross such area, install conduit below isolated slab, in supporting structural slab or below it. Stub-ups to equipment located on isolated slab shall be through openings at least 1/2" larger in diameter than outside diameter of conduit. Fill space between conduit and opening in slab with mastic.
- W. Expansion Joints
  - 1. Where embedded conduits cross building expansion or seismic joints, provide sliding conduit expansion joints with bonding strap and clamps.
  - 2. Where exposed conduits or conduits in furred spaces cross building expansion or seismic joints, use offset flexible conduit or sliding conduit expansion joint.
- X. Terminate conduits of 1" size and larger with insulated bushings with grounding lugs where required, O.Z. Type Bldg., or equal (no known equal).
- Y. Bends and sweeps for conduits used for telephone systems shall be long radius and factory made with the radius marked on them.
- Z. Flashings. Where conduits extend through roof, provide flashings as required by Division 7.
- AA. Penetration in Fire Rated Structures: Provide 3M or Dow Corning No. 3-6548, RTV Silicone form for making fire rated seals around penetrations through floors, walls, elevator shafts as minimum or mechanical fire stop fittings with UL listed fire rating or equal to wall or floor ratings, whichever is larger.
- BB. A separate conduit shall be installed for each homerun indicated on the Drawings.
- CC. Encase all nonmetallic feeder conduit installed underground in a 3-inch concrete envelope. Extend concrete envelopes a minimum of 3 inches beyond all external sides of all outermost conduits. Space the external surfaces of all conduit within a bank, a minimum of 3 inches apart, except that all sound, telephone, and data communication circuits contained within nonmetallic conduit shall have a minimum separation of 12 inches from any light or power circuits that parallel them within a bank. All underground conduits and duct banks containing high voltage feeders shall be encased in red concrete. Concrete shall be pre-mixed at the factory. Sprinkling red oxide in field is not acceptable. All underground conduits to be installed a minimum 36" below grade. Use manufactured concrete or plastic spacers to insure required concrete coverage. Concrete shall be minimum 2500 psi.
- DD. Provide a plastic warning tape in the backfill over the ductlines and approximately 12 inches below grade. Tape shall be run continuously along the entire length of the underground utility lines. Tape shall be polyethylene plastic manufactured specifically for warning and

identification of all buried utility lines. Tape shall be of the type provided in rolls, 6-inches minimum width, color coded for electric lines (red) and for communication lines (orange), with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be "CAUTION - BURIED ELECTRIC (or COMMUNICATION) LINE BELOW", or similar wording. Code and letter coloring shall be permanent, unaffected by moisture and other substances contained in trench backfill material.

- EE. During construction, partially completed duct lines shall be protected from the entrance of debris such as mud, sand and dirt by means of suitable conduit plugs. As each section of a duct line is completed from manhole to vault, a testing mandrel not less than 12 inches long with a diameter 1/4-inch less than the size of the conduit, shall be drawn through each conduit, after which a brush having the diameter of the duct, and have stiff bristles shall be drawn through until the conduit is clear of all particles of earth, sand, gravel and other foreign materials. Conduit plugs shall then be immediately installed.
- FF. Maintain minimum 6-inch clearance between conduit and piping. Maintain 12-inch clearance between conduit and heat sources such as flues, steampipes, hot water pipes, and heating appliances.
- GG. Tag all empty conduits at each accessible end with a permanent tag identifying the purpose of the conduit and the location of the other end. In wet, corrosive outdoor or underground locations, use brass, bronze, or copper 16 gauge tags or lead tags secured to conduit ends with #16 or larger galvanized wire. Inscribe on the tags, with steel punch dies, clear and complete identifying information.
- HH. Provide expansion and deflection fittings where two rigidly supported conduits may move in relation to each other at expansion joint crossings.
- II. From each panel which is flush mounted in a wall, stub from top of the panel, a minimum of 4-3/4-inch conduits to the nearest ceiling space or other accessible location and cap for future use.
- JJ. Conduits which are installed above dry type suspended ceilings shall not be secured to ceiling support wires. Support such conduit independent of ceiling suspension systems.
- KK. Underground duct-banks shall have continuous slope downward toward manholes and away from buildings with a pitch of not less than 4 inches in 100 feet. Changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet, except that manufactured bends may be used at ends of short runs of 100 feet or less, and then only at or close to the end of run.
- LL. Exposed conduit larger than 1 inch shall be suspended with pipe hangers. Hangers and racks shall be attached to concrete with insets, set at the time the concrete is poured, and to steel members with beam clamps or matching bolts.
- MM. Conduit 1-inch and smaller, in metal and stud partitions, shall be tied to the furring channels with No. 12 gauge galvanized tie wire space not more than 5 feet apart. Conduits above metal channel lath and plaster ceilings for other services and lighting home runs shall be supported independently to the slab.

- NN. Wherever conduits pass through concrete walls, suspended slabs or metal deck floors, furnish and install sleeves of ample size to permit installation of conduit. Sleeves shall be installed prior to pouring of concrete and shall have ends flush with the wall or extend 2 inches above floor surfaces. Verify location with the University's Representative.
- OO. Except as otherwise indicated on the Drawings, bends in conduit 2 inches or larger shall have a radius of curvature of the inner edge, equal to not less than ten (10) times the internal diameter of the conduit. Any deviations from this radius shall be approved by the University's Representative. Wire or cable bends in junction or pull boxes shall be made with a long radius. Bends for 600-volt cable shall have a radius of not less than five (5) times the diameter of the cable. Nesting of conduits shall be made when two or more conduits are run in parallel. High voltage feeder conduit runs (above 600 volts), telephone and closed-circuit television conduit runs shall not have more than two 90-degree long radius bends. All other conduit runs (below 600 volts) shall not have more than three 90-degree long radius bends between pull boxes, junction boxes or terminal cabinets.
- PP. Conduit shall not be run closer than 6 inches on the top of light fixtures and cable trays. Do not install conduit on the sides of the cable tray or within 6 inches below the tray.
- QQ. All control apparatus, outlet boxes, junction and pull boxes, and other similar equipment shall be installed and maintained in accessible positions and locations.
- RR. Conduits in furred spaces shall be routed to clear access openings.
- SS. Where steel conduits enter a concrete floor below a surface mounted panelboard, they shall be encased in a concrete curb of sufficient height to match the height of the finished base file.
- TT. Holes for conduits through existing concrete walls or floors shall be made by the "core-drill" method. Core drilling time shall be coordinated with University's Representative to avoid noise problem.
- UU. Upon completing the installation of any run of conduit, the runs shall be tested to see that they are free from all obstructions and have a smooth interior. Each end of each conduit run shall be plugged with "pennies" and bushings and left plugged until ready to pull circuit wires.
- VV. A 6-inch square by 2 foot deep concrete block with an embedded brass nameplate shall be installed over the ends of all spare conduits stubbed out of the Building, indicating the origin of the conduits. Verify location with University's Representative prior to rough-in.
- WW. Telephone and signal conduits placed in the same trench with power service conduit must be separated by no less than 12" of well packed earth or 3" of concrete.
- XX. Underground conduits for branch circuits without concrete encasement shall have 6-inch thick envelope of sand all around. Conduit installed in unpaved or planted areas shall have 6 inches of sand below and 2-inch thick cap of lean concrete on top.
- YY. Avoid installing conduits underneath the building.
- ZZ. The ends of all underground conduits entering pullboxes, manholes, etc. shall terminate in end bells and shall be capped or sealed with an approved compound, Crouse Hinds "Chico A", or

equal (no known equal) after installation of wire. Cap empty conduit stubouts at both ends. In landscaped areas, terminate in a waterproof J-box. Junction boxes located above grade in the landscaped areas shall have factory made gaskets, stainless steel screws and factory painting.

- AAA. Limit to a minimum the routing of conduits within the planting areas of parking lot dividers. Do not run conduit within the planting area parallel to the long dimension of the divider. Coordinate the routing of service conduits to lighting standards and landscape lighting fixtures to avoid conflict with trees and major shrubs.
- BBB. Underground conduits containing wiring for irrigation system shall not be permitted inside the high voltage (600V & above) manholes or pullboxes.
- CCC. Branch circuit conduits from the panelboard to the loads shall be installed on the same floor above the accessible ceiling.
- DDD. A green ground conductor shall be run in all conduits.

**3.2 BOXES, OUTLETS AND SUPPORTS:** Provide boxes in wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when installed exposed up to 7 feet above interior floors, when installed under raised floor or when installed in hazardous areas. Boxes in other areas shall be sheet steel. Each box shall have volume required by NFPA 70 for number of conductors enclosed in the box. Provide gaskets for cast-metal boxes installed in wet locations.

### **3.3 JUNCTION AND PULL BOXES**

- A. Wherever possible use outlet boxes for junction and pull boxes.
- B. Locate interior junction and pull boxes in machine rooms, equipment rooms, storage rooms, electrical rooms and similar utility spaces unless otherwise indicated or approved. Where junction or pull boxes must be used in finished areas, use flush boxes only equipped with prime finished sheet metal plates. Fasten plates to boxes with countersunk flat head screws. Provide plates with 3/4" trim all around.
- C. Do not use sectionalized boxes except where indicated. Do not mix feeder and branch circuit conductors in a common pull or junction box.
- D. Where more than one circuit passes through a common junction or pull box, tag conductors to indicate circuit number and panel designation.

**END OF SECTION 26 05 33**

## SECTION 26 05 43 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks.
  - 2. Handholes and boxes.

#### 1.3 DEFINITION

- A. RNC: Rigid nonmetallic conduit.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Duct-bank materials, including separators and miscellaneous components.
  - 2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
  - 3. Accessories for handholes and boxes.
  - 4. Warning tape.
- B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
  - 1. Duct entry provisions, including locations and duct sizes.
  - 2. Reinforcement details.
  - 3. Grounding details.
  - 4. Joint details.
- C. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
  - 1. Duct entry provisions, including locations and duct sizes.

2. Cover design.
3. Grounding details.
4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Duct-Bank Coordination Drawings: 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. Product Certificates: For concrete and steel used in precast concrete handholes, as required by ASTM C 858.
- C. Qualification Data: For professional engineer and testing agency.
- D. Source quality-control test reports.
- E. Field quality-control test reports.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Comply with ANSI C2.
- C. Comply with NFPA 70.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.
- B. Store **precast concrete** underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support precast concrete units only at designated lifting or supporting points.

## 1.8 PROJECT 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 Architect, Construction Manager and Owner no fewer than 14 days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Architect's, Construction Manager's and Owner's written permission.

## 1.9 COORDINATION

- A. Coordinate layout and installation of ducts, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into handholes and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to handholes, and as approved by Architect.

## 1.10 EXTRA MATERIALS

- 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.
- B. Furnish cable-support stanchions, arms, **insulators**, and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

## PART 2 - PRODUCTS

### 2.1 CONDUIT

- A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- B. RNC: NEMA TC 2, Type EPC-40-PVC UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

### 2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Cantex, Inc.
  2. CertainTeed Corp.; Pipe & Plastics Group.
  3. Condux International, Inc.



- C. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type DB-60-PVC, ASTM F 512, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.
- D. Duct Accessories:
  - 1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
  - 2. Warning Tape: Underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

### 2.3 PRECAST CONCRETE HANDHOLES AND BOXES

- 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Oldcastle Precast Group.
  - 2. Riverton Concrete Products; a division of Cretex Companies, Inc.
  - 3. Utility Concrete Products, LLC.
  - 4. Utility Vault Co.
- C. Comply with ASTM C 858 for design and manufacturing processes.
- D. 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.
  - 1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
  - 2. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
  - 3. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.
    - a. Cover Hinges: Concealed, with hold-open ratchet assembly.
    - b. Cover Handle: Recessed.
  - 4. Frame and Cover: Weatherproof aluminum frame with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts.
    - a. Cover Hinges: Concealed, with hold-open ratchet assembly.
    - b. Cover Handle: Recessed.
  - 5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  - 6. Cover Legend: Molded lettering, "ELECTRIC".

7. Configuration: Units shall be designed for flush burial and have **closed** bottom, unless otherwise indicated.
8. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
  - a. Extension shall provide increased depth of 12 inches.
  - b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
9. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
  - a. Windows 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.
  - b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
  - c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
10. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
  - a. Type and size shall match fittings to duct or conduit to be terminated.
  - b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.
11. 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.

## **2.4 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE**

### **A. Description: Comply with SCTE 77.**

1. Color: **Gray.**
2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC."
6. 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.
7. Duct Entrance Provisions: Duct-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 shall have factory-installed inserts for cable racks and pulling-in irons.
- B. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
  1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  2. Manufacturers: Subject to compliance with requirements, provide or a comparable product by one of the following:
    - a. Armorcast Products Company.
    - b. Carson Industries LLC.
    - c. Christy Concrete Products.
    - d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.

## **2.5 SOURCE QUALITY CONTROL**

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.
- B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of 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 a independent testing agency.
  2. Strength tests of complete boxes and covers shall be by either an independent testing agency or the 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 UNDERGROUND DUCT APPLICATION**

- A. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.
- B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.
- C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.
- D. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

- E. Underground Ducts Crossing Paved Paths Walks and Driveways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

### 3.2 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-20 structural load rating.
  - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
  - 3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
  - 4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.

### 3.3 EARTHWORK

- A. Excavation and Backfill: Comply with Section 312300 "Excavation and Fill," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329300 "Plants."
- D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Section 017329 "Cutting and Patching."

### 3.4 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward handholes and away from buildings and equipment.
- B. 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.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Duct Entrances to Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, 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 line slope and without forming a trap in the line.
  2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to handhole.
  3. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit 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 duct-to-conduit transition. Install conduit penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf- test nylon cord in ducts, including spares.
- H. Concrete-Encased Ducts: Support ducts on duct separators.
1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. 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.
  2. Concreting Sequence: Pour each run of envelope between terminations in one continuous operation.
    - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, 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 18 inches into concrete on both sides of joint near corners of envelope.
  3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
  4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
  5. 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.

6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
7. Depth: Install top of duct bank 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.
8. Stub-Ups: Use manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Extend concrete encasement throughout the length of the elbow.
9. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
  - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
10. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the 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.

I. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Section 312300 "Excavation and Fill" for pipes less than 6 inches in nominal diameter.
4. Install backfill as specified in Section 312300 "Excavation and Fill."
5. After installing first tier of ducts, 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 ducts 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 as specified in Section 312300 "Excavation and Fill."
6. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.

7. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
10. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
  - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

### 3.5 INSTALLATION OF CONCRETE HANDHOLES, AND BOXES

#### A. Precast Concrete Handhole Installation:

1. Comply with ASTM C 891, unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts 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.

#### B. Elevations:

1. Install handholes with bottom below the frost line, below grade.
2. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
3. Where indicated, cast handhole cover frame integrally with handhole structure.

#### C. Waterproofing: Apply waterproofing to exterior surfaces of handholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Section 071353 "Elastomeric Sheet Waterproofing." After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars.

#### D. Dampproofing: Apply dampproofing to exterior surfaces of handholes after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, dampproof joints and connections and touch up abrasions and scars.

#### E. 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.

- F. Field-Installed Bolting Anchors in Concrete Handholes: Do not drill deeper than 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

### **3.6 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 ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the 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 so cover surface will be flush with finished grade. Set covers of other handholes 1 inch above finished grade.
- D. Install handholes and boxes with bottom below the 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 the enclosure.
- F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. 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 033000 "Cast-in-Place Concrete," with a troweled finish.
  - 2. Dimensions: 10 inches wide by 12 inches deep.

### **3.7 GROUNDING**

- A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

### **3.8 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections and prepare test reports:



1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
  2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
  3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

### **3.9 CLEANING**

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of handholes. Remove foreign material.

**END OF SECTION 26 05 43**

## **SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING**

### **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 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 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

### **PART 2 - PRODUCTS**

#### **2.1 SLEEVES**

- A. Wall Sleeves:
  - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, 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 D 1785, 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. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Advance Products & Systems, Inc.
    - b. CALPICO, Inc.
    - c. Metraflex Company (The).
    - d. Pipeline Seal and Insulator, Inc.
    - e. Proco Products, Inc.
  - 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Carbon steel.
  - 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, 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.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Presealed Systems.

## **2.4 GROUT**

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, 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.
  - 2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 3. Sealant 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."
- 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 079200 "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 26 05 44**

## SECTION 26 05 48 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Provide vibration isolation for electrical equipment.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Provide vibration isolators of the appropriate sizes with the proper loading capacity to meet the specified deflection requirements.
- B. All metal parts of vibration isolation units installed outdoors shall be cold-dip galvanized, cadmium plated, or neoprene coated after fabrication.
- C. All isolators installed outdoors shall have base plates with bolt holes for fastening the isolators to the support members.
- D. All vibration isolation mounts shall be supplied by one of the following approved manufacturers.
  - 1. Mason Industries Inc. (Anaheim, CA) - MI.
  - 2. California Dynamic Corporation (Los Angeles, CA) - CalDyn.
  - 3. Kinetics Noise Control Inc. (Santa Fe, CA) - KNC.
  - 4. Or equal
- E. Vibrator Isolator Types
  - 1. General Properties
    - a. Springs shall be so designed that the ratio of horizontal stiffness to vertical stiffness is approximately 1.
    - b. Spring isolators shall have diameter not less than 0.8 of the compressed height of the spring at the rated load.
  - 2. Isolator Description
    - a. Type MS shall be spring type, without housings or snubbers, equipped with leveling bolts and with two layers of ribbed or waffled neoprene pads, separated by a 1/16" galvanized steel plate under the base plate. Neoprene sleeves and washer shall be installed at all anchor bolts.
    - b. Type HS shall be suspension hangers having a steel frame and spring element, in series with a neoprene pad, cup or washer. The isolator shall be designed so that

hanger rod may be misaligned 15 degrees in any direction relative to the vertical, without contacting hanger box frame.

- c. Type BN shall be formed by two layers of 1/4" to 5/16" thick ribbed waffled neoprene sandwiches between two stainless steel or aluminum plates.
- d. Type HN shall consist of a neoprene-in-shear element contained within a steel housing. A neoprene neck bushing shall be provided where the hanger rod passes through the hanger housing to prevent the rod from contacting the hanger housing. The diameter of the hole in the housing shall be sufficient to permit the hanger rod to swing through a 30 degree arc before contacting the hanger housing.

### **PART 3 - EXECUTION**

#### **3.1 BASES AND FOUNDATIONS FOR ELECTRICAL EQUIPMENT**

- A. Building Substation Transformer: Support transformer and switchgear sections on neoprene mounts, Type B1EQ, sized for minimum static deflections of 0.20".
- B. Smaller Transformers: Smaller transformers shall be supported via neoprene pads, Type P2, sized for minimum static deflections of 0.10". Hold-down bolts must be further isolated via neoprene bushings, Type P3.
- C. Dimmers shall be supported via neoprene pads, Type P2, sized for minimum static deflections of 0.10". Mounting bolts must be further isolated via neoprene bushings, Type P3.
- D. Conduit connections to isolated transformers must be via flexible conduit installed with slack.

**END OF SECTION 26 05 48**



## **SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Nameplates and labels.
- B. Wire and cable markers.
- C. Medium voltage cable tags.
- D. Underground warning tape.
- E. Conduit markers.
- F. Warning Signs.

#### **1.2 REGULATORY REQUIREMENTS**

- A. Conform to requirements of ANSI/NFPA 70.

### **PART 2 - PRODUCTS**

#### **2.1 NAMEPLATES**

- A. Nameplate designations shall clearly state:
  - 1. Manufacturer's nameplate including equipment design rating of current, voltage, kVA, HP, bus bracing rating, or as applicable.
  - 2. Equipment nameplate designating system usage and purpose, system nominal voltage, equipment rating for kVA, amperes, HP and RPM as applicable.
  - 3. Receptacles and lighting switches (wiring devices): Panel designation and circuit number.
- B. Nameplates shall be melamine plastic, 0.125-inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering into the black core. Minimum size of nameplates shall be 1.0 inch by 2.5 inches except that wiring device nameplates shall be 0.5 inch by 1.5 inch. Lettering shall be normal block style unless otherwise noted.
- C. Letter Size:
  - 1. Use 0.25 inch letters for identifying individual equipment and loads.
  - 2. Use 0.50 inch for identifying grouped equipment and loads.

## 2.2 WIRE MARKERS

- A. Description: Heat shrinkable, flame-retarded, crosslinked polyolefin wire marker. Wire tags shall have a dielectric strength of 500 V/mil minimum and a temperature range from -30°C to 105°C. Thermoplastic or wraparound tags are not acceptable. All tags shall be printed using a 9 or 24 pin dot matrix printer. Raychem ShrinkMark™, Brady Permasleeve or approved equal.
- B. Legend:
  - 1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.

## 2.3 UNDERGROUND WARNING TAPE:

- A. The tape shall be 6" wide x 0.004" polyethelene plastic with a metallic core detection tape. The tape shall be of a bright color contrast with soil, with identifying printing on one side. The imprint shall read "Caution (type of utility) Line Buried Below". The identifying lettering shall be repeated continuously the full length of the tape. Seton style 6ELE, THOR Enterprises or approved equal.

## 2.4 CONDUIT MARKERS: ANSI Z35.1 G.2.

- A. Pressure-sensitive, adhesive-backed vinyl markers with fade-proof ultraviolet inhibitors, black characters on orange background. 2.25" x 9" marker with 1.5" high letters. Marker shall read "4160 VOLTS" or "12000 VOLTS" depending on circuit phase-to-phase voltage. Carlton Industries type EM-1, Seton Code Electrical Markers style AA, Brady B-500 series or approved equal.

## 2.5 MV CABLE TAGS

- A. Provide as indicated on the plans.

## 2.6 WARNING SIGNS: ANSI Z35.1, Z35.2 and Z35.5.

- A. Warning signs shall be minimum 18 gauge steel white porcelain enamel finish with red lettering. Lettering to read "DANGER - HIGH VOLTAGE" with "DANGER" in 1-1/2" letters and "HIGH VOLTAGE" in 1" letters. New warning signs shall be provided on door/gate or immediately above door of all electrical equipment rooms, vaults, closets or outdoor substations containing equipment energized above 150 volts to ground, except where such spaces are accessible from public areas.
- B. Warning designations in 1" red letters shall be painted by stencil or pre-printed adhesive on each new pull box or cabinet stating "DANGER" and giving voltage of enclosed conductors such as "DANGER - 12,000 VOLTS", for all systems over 150 volts to ground.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Degrease and clean surfaces to receive nameplates and labels.
- B. Coordinate installation of nameplates, markers and warning signs with the sequence of painting. Refer to Section 099100, "Painting."

### **3.2 NAMEPLATES**

- A. Provide laminated plastic nameplates for all electrical equipment and devices including, but not limited to, the following:
  - 1. Enclosures for switchgear, medium voltage controllers, transformers, low voltage switchgear, motor control centers, variable frequency drives, panels, panelboards, busway, pull boxes, junction boxes, cabinets and motors.
  - 2. Enclosures for all separately enclosed devices including but not limited to disconnect switches, circuit breakers, contactors, time switches, control stations and relays.
  - 3. All receptacles and lighting switches.
  - 4. Special systems such as but not limited to telephone, warning and signal systems. Identification shall be at each equipment rack, terminal cabinet, control panel, annunciator, and pull box.
  - 5. Devices mounted within and part of an equipment including circuit breakers, switches, control devices, control transformers, relays, indication devices and instruments.
- B. **MOUNTING:** Provide number, location, and letter designation of nameplates as indicated. Install nameplate parallel to equipment lines. Fasten nameplates to enclosures with a minimum of two sheet-metal screws or two rivets. Fasten nameplates to device plates with suitable adhesive. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

### **3.3 WIRE MARKERS:**

- A. Provide markers for each conductor at panelboard gutters, pull boxes, junction boxes, outlet boxes, and each load connection.

### **3.4 UNDERGROUND WARNING TAPE:**

- A. Identifying tapes shall be buried in all utility line trenches. Each trench shall have one tape above the centerline of each duct. In non-paved areas, the tape shall be located approximately 8" below the final finish grade. In areas where paving is to be installed, the tape shall be placed immediately below the paving or its sub-base.

**3.5 CONDUIT MARKERS:**

- A. Provide markers on all exposed conduit for circuits greater than 600 volts. Provide markers at lengths not greater than 20 feet on center.

**3.6 MV CABLE TAGS:**

- A. All new cables installed shall be identified at each end and at all accessible points in between (such as manholes, pull boxes, switchgear, etc.). Identify existing cables that are being re-routed or changed with new tags. Modification of existing tags shall not be acceptable.

**3.7 WARNING SIGN MOUNTING:**

- A. Signs shall be permanently mounted with cadmium plated steel screws or nickel-plated brass bolts.

**END OF SECTION 26 05 53**

## SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Commissioning
- B. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the owner's project requirements and operational needs. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, performance testing and training. Commissioning during the construction phase is intended to achieve the following specific objectives:
  - 1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
  - 2. Verify and document proper functional performance of equipment and systems.
  - 3. Verify that O&M documentation left on site is complete.
  - 4. Verify that the Owner's operating personnel are adequately trained.
- C. Facility Grid
  - 1. The CxA utilizes, Facility Grid, cloud-based and mobile commissioning software platform to execute commissioning activities and deliverables. <https://facilitygrid.com/> CxA will provide project team members introduction to Facility Grid's platform.
  - 2. Facility Grid will allow CxA, facility managers, architects, contractors, maintenance personnel, and corporate administrators can actually see and operate in the same loop real time. This transparency opens the door to major short and long-term efficiencies in all phases of the facilities management process.
  - 3. Facility Grid defines the future of commissioning software by increasing the efficiency of commissioning agents, by streamlining commissioning projects and record keeping, by enabling project managers to see the big and small pictures in real time, across all projects, and by providing owners with a database of building information to benefit from today and in the future.
    - a. Real-Time Collaboration
    - b. Transparency
    - c. Team Engagement
    - d. Accountability
    - e. Information Sustainability

#### 1.2 RELATED WORK

- A. Division 01 – General Requirements

1. Section 013300 – Submittal Procedures
2. Section 017700 – Closeout Procedures
3. Section 019113 – General Commissioning Requirements

### **1.3 ABBREVIATIONS AND DEFINITIONS**

- A. A/E: Design Professional
- B. ASI: Architectural Supplemental Instruction
- C. BAS: Building Automation System
- D. BoD: Basis of Design. A narrative of how the designer plans to achieve the OPR
- E. CxA: Commissioning Authority
- F. Controls Contractor
- G. CM: Construction Manager
- H. Cx: Commissioning
- I. Cx Plan: Commissioning Plan
- J. Cx RFI: Commissioning Request for Information
- K. DDC: Direct Digital Control System
- L. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents and cannot be corrected in five (5) minutes time.
- M. EC: Electrical Contractor
- N. FBO: Furnished By Others
- O. FT: Functional Performance Test
- P. GC: General Contractor
- Q. IAW: In Accordance With
- R. MC: Mechanical Contractor
- S. O&M: Operation and Maintenance
- T. OPM: Owner Project Manager

- U. OPR: Owner Project Requirement. A dynamic document expressing how the owner expects the building systems to perform upon project completion.
- V. PC: Prefunctional Checklist
- W. RFI: Request for Information
- X. Sub(s): Subcontractors or Prime Contractor
- Y. TC: Testing Contractor
- Z. TBD: To Be Determined

#### **1.4 ELECTRICAL EQUIPMENT AND SYSTEMS TO BE COMMISSIONED**

The specific systems that shall be commissioned include:

- A. Electrical Systems (and all integral equipment controls)
  - 1. Exterior & Interior Lighting
  - 2. Smart Meter - Main Switchboard (4DB1)
  - 3. Emergency Power Inverter Lighting
  - 4. Light Control System

#### **1.5 SUBMITTALS**

- A. Refer also to Specification Section 019113, Subsection 1.6.
- B. Provide the CxA a copy of the following items, for the systems to be commissioned:
  - 1. Equipment and System Submittals to include, at minimum, the following:
    - a. Cut Sheets
    - b. Performance data
  - 2. Manufacturer's pre-startup checklists
    - a. Manufacturer's start-up checklists
    - b. Installation Instructions
  - 3. Shop drawings (including any resubmittals required by the A/E)
  - 4. Protective device settings
  - 5. Completed field test report, including all completed forms and checklist; and list of all outstanding deficiencies and uncompleted items
  - 6. Operational and maintenance documentation
  - 7. Training plan and training materials
  - 8. As-built documentation

## **PART 2 - PRODUCTS**

### **2.1        TEST EQUIPMENT**

- A.    Refer to Specification Section 019113, Subsection 2.1.

## **PART 3 - EXECUTION**

### **3.1        MEETINGS**

- A.    Refer to Specification Section 019113, Subsection 3.3.

### **3.2        START-UP, PREFUNCTIONAL CHECKLISTS, AND INITIAL CHECKOUT**

- A.    The following procedures apply to all equipment to be commissioned, according to Subsection 1.4 above.
- B.    General
  - 1.    Prefunctional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
  - 2.    Independent Testing Agencies: For systems where independent testing agencies (TC) are specified, the cost of this testing is borne by the contractor. Much of the testing performed by these independent agencies will cover aspects required in the commissioning start ups and functional performance tests requirements. Contractor and testing agencies shall coordinate with the CxA so that they can witness the testing and approve the applicable aspects of the FPTs. CxA may in some cases independently spot check work of the testing agencies if the tests were not witnessed. However it is not the intent for the TC to accomplish testing that is specified in the construction specifications. For instance much of the testing requirements for the Electrical Testing will be performed by the independent electrical testing agency provided with under the contract. CxA will witness the indicated sample of the TC testing and record the results in the record of functional performance testing.
- C.    Start-up and Initial Checkout Plan
  - 1.    The CxA will provide prefunctional checklists (PCs). PCs indicate the required procedures to be executed as part of startup and initial checkout of the systems.
  - 2.    The subcontractor responsible for providing and installing the equipment develops the full start-up plan by combining (or adding to) the CxA's prefunctional checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures



with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.

3. The full start-up plan shall consist of:
  - a. The CxA's prefunctional checklists.
  - b. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end
  - c. The manufacturer's normally used field checkout sheets
4. The contractor submits the full startup plan to the CxA for review and approval.
5. The CxA reviews and approves the procedures and the format for documenting them, noting any plans that need to be added.

D. Execution of Prefunctional Checklists and Startup

1. Two weeks prior to startup, the Subs and vendors shall schedule startup and checkout with the CM, GC and CxA. The performance of the prefunctional checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off prefunctional checklists, signatures may be required of other Subs for verification of completion of their work.
2. The CxA and possibly the A/E will observe the procedures and tests for selected pieces of primary equipment. It is the intent the CxA will observe the tests during contractor testing. If the contractor does not inform the CxA of testing, the CxA may request the contractor to repeat the test.
3. The CxA will observe the physical start-up of all major systems.
4. The Subs and vendors shall execute startup and provide the GC with a signed and dated copy of the completed start-up and prefunctional tests and checklists. The GC reviews for completion and accuracy, then submits to the CxA and A/E.
5. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.
6. Completed startup testing report must be provided to CxA prior to functional testing.

E. Deficiencies, Non-Conformance and Approval in Checklists and Startup

1. The Sub(s) shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully. The procedures form and any outstanding deficiencies shall be provided to the CxA within two days of test completion.
2. The CxA will work with the Sub(s) and vendors to determine what is required to correct outstanding deficiencies and retest deficiencies of uncompleted items. The CxA will involve the CM, GC and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CxA as soon as outstanding items have been corrected.
3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in back charges to the responsible party. Refer to Section 019113, 3.6 – DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS.

### 3.3 FUNCTIONAL PERFORMANCE TESTING - DEMONSTRATION

- A. This subsection applies to functional testing for equipment and system in this division.
- B. The general list of equipment and systems to be commissioned is found in Subsection 1.4.
- C. Objectives and Scope.
  - 1. The objective of functional performance testing is to demonstrate that each system is operating according to the owner's project requirements, documented project program, and Contract Documents. Functional testing facilitates bringing the systems from a state of material completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and function of the systems.
  - 2. In general, each system shall be operated through all modes of operation (occupied, unoccupied, failures, interlocks, safety, etc.) where there is a specified system response. Verifying each sequence in the sequences of operation is required.
  - 3. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.
  - 4. The contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, tools, instruments, ladders, lifts, computers, software, cables, etc. Contractor supplied personnel must be competent with and knowledgeable of all project-specific systems, and automation hardware and software. All training documentation, O&Ms, and submittals shall be at the job site before functional testing commences.
- D. Development of Test Procedures
  - 1. The CxA develops specific functional test procedures and forms to verify and document proper operation of each piece of equipment and system. The CxA provides a copy of the test procedures to the A/E, CM and installing Sub who shall review the tests prior to testing. The A/E and Sub(s) shall point out to the CxA any specific problems as related to feasibility, safety, equipment and warranty protection.
- E. Coordination and Scheduling
  - 1. The GC shall provide sufficient notice to the CxA regarding the Subs completion schedule for the prefunctional checklists and startup of all equipment and systems. The CxA will schedule functional tests after written notification from the GC and affected Subs. The CxA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.
  - 2. In general, functional testing shall not be scheduled until all hardware and software submittals are approved, Prefunctional checklists are approved, and start-up has been satisfactorily completed. Scheduling of functional testing shall be done with a minimum of two weeks' notice prior to testing. Functional testing of the equipment and systems listed in Subsection 1.04 of this specification section shall not be conducted out of the presence of the CxA and CM, unless specifically approved to do so in writing by the CxA or CM. Any functional testing which occurs outside the presence of the CxA or CM without written authorization to do so will be required to be re-tested at no expense to the owner.

F. Demonstration, Verification and Validation

1. The electrical systems demonstration shall include, at minimum, the following:
  - a. Exterior & Interior Lighting
  - b. Smart Meter - Main Switchboard (4DB1)
  - c. Emergency Power Inverter Lighting
  - d. Light Control System

G. Problem Solving

1. The CxA will recommend solutions to problems found; however, the burden of responsibility to solve, correct, and retest problems is with the GC, Subs and A/E.

**3.4 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS**

- A. Refer to Specification Section 019113, Subsection 3.6.

**3.5 OPERATION AND MAINTENANCE MANUALS**

- A. In addition to installation manuals, the contractor shall provide one copy of the Operation and Maintenance Manuals to the CxA for the systems to be commissioned. The O&M Manuals shall be provided to the CxA at least 8 weeks prior to the start of Functional Testing.

**3.6 TRAINING OF OWNER PERSONNEL**

- A. See Specification Section 019113, Subsection 3.8.
- B. Provide designated Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of electrical equipment or system.
- C. CxA shall attend a sample of the training sessions and validate that the training has occurred according to the specifications.

**3.7 DEFERRED TESTING**

- A. See Specification Section 019113, Subsection 3.9.

**APPENDIX A**

**EXAMPLE PREFUNCTIONAL CHECKLIST**

# System Name: Building Lighting Control

Serves: Building x

## Prefunctional Checklist

### 1. Verification

Pre-functional checklist items must be completed as part of startup & initial checkout, in preparation for Functional Performance Testing. The following items are complete and the system is ready for Functional Performance Testing:

- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable).
- The prefunctional checklist items are complete and have been signed off only by parties having direct knowledge of the event.
- Contractor’s assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- “Contr.” column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item.
- This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items.
- The installation is complete and ready for functional testing.

A/E	Architect/Engineer	All	All contractors	EC	Electrical contractor
CxA	Commissioning Agent	CC	Controls (BAS) Contractor	GC	General contractor
MC	Mechanical Contractor	TAB	TAB Contractor	LC	Lighting Controls Contractor

<i>Signature:</i>	<i>Signature:</i>	<i>Signature:</i>
_____	_____	_____
Date:	Date:	Date:
_____	_____	_____
<i>Name:</i>	<i>Name:</i>	<i>Name:</i>
_____	_____	_____
GC: General Contractor Company	EC: Electrical Contractor Company	LC: Lighting Controls Contractor Co.
<i>Signature:</i>	<i>Signature:</i>	<i>Signature:</i>
_____	_____	_____
Date:	Date:	Date:
_____	_____	_____
<i>Name:</i>	<i>Name:</i>	<i>Name:</i>
_____	_____	_____
Owner: Owner Representative Company		

### 2. Approvals

This prefunctional checklist has been completed and is approved with the exceptions noted below.

*Signature:*

\_\_\_\_\_

Date:

\_\_\_\_\_

*Name:*

\_\_\_\_\_

CxA: Commissioning Authority Company

**3. Installation Checks**

Enter N/A if not applicable. Enter note or # if deficient. Attach notes to this sheet.

<b>General Installation</b>	<b>Contractor</b>	<b>Check or Note or #</b>
Unit is free of physical damage	EC	
Units installed as required by manufacturer and construction documents	EC	
Layout and location of switches, occupancy sensors, photo cells per construction documents	EC	
Electrical and lighting panels schedule complete and affixed	EC	
Permanent identification (labels) affixed and visible	EC	
Wiring labeled inside panels to controlled components	EC	
Electrical and lighting panels properly grounded	EC	
Occupancy sensor shut off time is set for 1-hour	EC	

**4. Operational Checks**

Enter N/A if not applicable. Enter note or # if deficient. Attach notes to this sheet.

<b>Electrical</b>	<b>Contractor</b>	<b>Check or Note or #</b>
All over-ride, manual, timer and dimming switches verified operational	EC	
Exterior photo cell and time clock setup and verified operational	EC	
Daylighting controls setup and verified operational	EC	
Upon entering space served by occupancy sensor, the respective fixtures energize	EC	
After leaving space served by occupancy sensor, the respective fixtures turn off once 1-hour has elapsed	EC	
<b>Energy Management System</b>	<b>Contractor</b>	<b>Check or Note or #</b>
Lighting Controls, startup and point to point verified	LC	
Lighting System's full sequence of operations is verified and operational	LC	
BAS Operator Workstation graphical interface complete	LC	

**5. Notes:**

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\*Attach additional sheets if needed.

-- END OF CHECKLIST --

**APPENDIX B**

**EXAMPLE FUNCTIONAL TEST PROCEDURE**

## Functional Performance Test

### 1. System Description

The lighting control system consists of occupancy sensors, manual override switches and dimmers. Space lighting operates based upon time clock and occupancy sensors.

- **Building:** Building x
- **System:** Lighting Controls (occupancy sensors)
- **Make:** Lighting Controls
- **Model:** \_\_\_\_\_
- **Serial:** \_\_\_\_\_

### 2. Test Participants

Organization		Participation Capacity
General Contractor	General Contractor Company	Provide assistance as needed for corrective items. Verify that items are completed, keep track of schedule.
Electrical Contractor	Electrical Contractor Company	Provide testing support and NIST certified instrumentation for checks outlined herein.
Lighting Controls Contractor	Lighting Controls Contractor Company	Provide adjustment of control system as needed and provide access to lighting control system.
Owner's O&M Personnel	Owner Representative Company	<i>Optional</i>
Commissioning Authority	Commissioning Authority Company	Along with the controls contractor, perform the functional performance testing as Independent third party witness and documenting functional performance results.

### 3. Approvals

We the undersigned participated in this functional test, acknowledge that the functional testing process for the equipment has been completed and that noted deficiencies or corrective actions noted have been made.

Signature:	Signature:	Signature:
Date:	Date:	Date:
Name:	Name:	Name:
GC: General Contractor Company	EC: Electrical Contractor Company	LC: Lighting Controls Contractor Co
Signature:	Signature:	Signature:
Date:	Date:	Date:
Name:	Name:	Name:
Owner: Owner Representative Co.	CxA: Commissioning Authority Co.	



#### 4. Test Prerequisites

General Contractor to verify following items have been completed and system is ready for functional testing:

- Site checks of the prefunctional checklist and manufacturer startup reports completed successfully.
- Control system programmed and operable per contract documents, including final set points and schedules and logic debugged
- A/E deficiency items for this equipment are completed
- Functional Performance Test procedures have been reviewed and approved by installing contractors
- Safety controls and operating ranges are set, activated and checked

Initial Test		Start Date	End Date	Initials
Results (check one) <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Partial Test w/ Corrective Actions <input type="checkbox"/> Complete Test w/ Corrective Actions <input type="checkbox"/> Other	Explanation:			

Re-Test 1		Start Date	End Date	Initials
Results (check one) <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Partial Test w/ Corrective Actions <input type="checkbox"/> Complete Test w/ Corrective Actions <input type="checkbox"/> Other	Explanation:			

Re-Test 2		Start Date	End Date	Initials
Results (check one) <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Partial Test w/ Corrective Actions <input type="checkbox"/> Complete Test w/ Corrective Actions <input type="checkbox"/> Other	Explanation:			

### 5. Operation Schedule

- Space lighting can be assigned to schedule
- Off hours override time limit is no more than 2-hours

Day	AM											PM												
	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11
Sun																								
Mon																								
Tues																								
Wed																								
Thurs																								
Fri																								
Sat																								
Holi																								

### 6. Functional Testing Procedures

The Commissioning Authority will make and document any changes, additions or deletions to this test procedure required by current system conditions (i.e. utility availability, etc.)

Y = Checked and Passed

R = Retest (check if retest required)

N = Not Passed

C = Corrected (check if correction verified)

Line	Mode ID	Action	Expected Response	Y	N	Comments	R	C
1	Occupancy Sensor Occupied Condition	With the schedule in occupied mode and space lighting operated based upon occupancy sensor is off;	Verify at Lighting Controls and by visual inspection that -	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
		Upon entering space the lighting activates immediately.  OR  Upon entering space the occupancy sensor indicates an occupied space and lights must be turned on manually	Lights turn on  Manual light switch turned on then light turn on	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
2	Occupancy Sensor Unoccupied Condition	With the schedule in occupied mode and space lighting operated based upon occupancy sensor is on;	Verify at Lighting Controls and by visual inspection that -	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
		After exiting the space for maximum 30-minutes the lights deactivate	Lights turn off  Record maximum runtime of lights from start of unoccupied condition: _____ (30) minutes	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
3	Occupancy Sensor Multi-Level Switching	With the schedule in occupied mode and space lighting operated based upon occupancy sensor is off;	Verify at Lighting Controls and by visual inspection that -	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
		Upon entering space the first stage (30-70%) of lighting activates manually or	Lights turn on	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>

		automatically.  After first stage of lighting energized, manual switches are provided to activate the remaining lighting (100%) and manually deactivate all lights	Manual light switch activated then 100% lights turn on  Turn off manual light switch and all lights turn off	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
4	Automatic Time Switch Control Occupied Condition	With the schedule in unoccupied mode and space lighting off;  Adjust time clock to enable occupied mode	Verify at Lighting Controls and by visual inspection that -  Lighting controls operate normally to turn on/off space lighting.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
5	Automatic Time Switch Control Unoccupied Condition	With the schedule in occupied mode and space lighting controlled as required;  Adjust time clock to be in unoccupied mode	Verify at Lighting Controls and by visual inspection that -  Non-emergency lighting turns off. Manual override switches only allow 2-hours maximum override	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>

### 7. Occupancy Sensors' Locations

The Commissioning Authority will make and document any changes, additions or deletions to this test procedure required by current system conditions (i.e. utility availability, etc.)

Y = Checked and Passed  
N = Not Passed

R = Retest (check if retest required)  
C = Corrected (check if correction verified)

Location	Room #	Line 1		Line 2		Line 3		Line 4		Line 5		Comments
		Y	N	Y	N	Y	N	Y	N	Y	N	
Suite	xxx	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Men's Restroom	xxx	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Women's Restroom	xxx	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

### 8. Lighting Controls System Verification

Verify the Building Management System's operator workstation dynamic graphics reflect an actual depiction of the system's configuration and operation.

Y = Checked and Passed  
N = Not Passed

R = Retest (check if retest required)  
C = Corrected (check if correction verified)

Line	Expect	Y	N	Comments	R	C
1	Space lighting matches contract documents	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
2	Occupancy sensors show real-time status	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
3	Space lighting enable/disable point, status and other commandable points shown.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
4	Lighting control system time clock set by scheduler and schedule shown.	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>

**9. Notes:**

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\* Attach additional sheets if needed.

Note: Items of non-compliance to the test requirements will be noted on the Master Commissioning Deficiency Log. The deficiency log will contain information such as date found, equipment/system involved, potential cause, responsibility and potential remedial actions. The contractor/supplier is expected to use their collective expertise to solve the problem(s) or replace defective equipment.

-- END OF TEST --

**END OF SECTION 26 08 00**

## SECTION 26 09 13 - ELECTRICAL POWER MONITORING AND CONTROL

### 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 for monitoring of electrical power system:
  - 1. PC-based workstation(s) and software.
  - 2. Communication network and interface modules for RS-485, Modbus TCP/IP data transmission protocols.

#### 1.3 DEFINITIONS

- A. Ethernet: Local area network based on IEEE 802.3 standards.
- B. Firmware: Software (programs or data) that has been written onto read-only memory (ROM). Firmware is a combination of software and hardware. Storage media with ROMs that have data or programs recorded on them are firmware.
- C. HTML: Hypertext markup language.
- D. I/O: Input/output.
- E. KY Pulse: A term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay changing status in response to the rotation of the disk in the meter.
- F. LAN: Local area network; sometimes plural as "LANs."
- G. LCD: Liquid crystal display.
- H. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or remote-control, signaling and power-limited circuits.
- I. Modbus TCP/IP: An open protocol for exchange of process data.
- J. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

- K. PC: Personal computer; sometimes plural as "PCs."
- L. rms: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.
- M. RS-232: A TIA standard for asynchronous serial data communications between terminal devices.
- N. RS-485: A TIA standard for multipoint communications using two twisted-pairs.
- O. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- P. THD: Total harmonic distortion.
- Q. UPS: Uninterruptible power supply; used both in singular and plural context.
- R. WAN: Wide area network.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
  - 1. Attach copies of approved Product Data submittals for products (such as switchboards and switchgear) that describe power monitoring and control features to illustrate coordination among related equipment and power monitoring and control.
- B. Shop Drawings: For power monitoring and control equipment. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Outline Drawings: Indicate arrangement of components and clearance and access requirements.
  - 2. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
  - 3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 4. Wiring Diagrams: For power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
  - 5. UPS sizing calculations for workstation.
  - 6. Surge Suppressors: Data for each device used and where applied.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified manufacturer.

- B. Field quality-control reports.
- C. Other Informational Submittals:
  - 1. Manufacturer's system installation and setup guides, with data forms to plan and record options and setup decisions.

## **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For power monitoring and control units, to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - 1. Operating and applications software documentation.
  - 2. Software licenses.
  - 3. Software service agreement.
  - 4. PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Software shall include system restore, emergency boot diskettes, and drivers for all installed hardware. Provide separately for each PC.
  - 5. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.
- B. Software and Firmware Operational Documentation:
  - 1. Self-study guide describing the process for setting equipment's network address; setting Owner's options; procedures to ensure data access from any PC on the network, using a standard Web browser; and recommended firewall setup.
  - 2. Software operating and upgrade manuals.
  - 3. Software Backup: On a magnetic media or compact disc, complete with Owner-selected options.
  - 4. Device address list and the set point of each device and operator option, as set in applications software.
  - 5. Graphic file and printout of graphic screens and related icons, with legend.
- C. Software Upgrade Kit: For Owner to use in modifying software to suit future power system revisions or power monitoring and control revisions.
- D. Software licenses and upgrades required by and installed for operating and programming digital and analog devices.

## **1.7 QUALITY ASSURANCE**

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

- B. **Manufacturer Qualifications:** A firm experienced in manufacturing power monitoring and control equipment similar to that indicated for this Project and with a record of successful in-service performance.
- 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.

## **1.8 COORDINATION**

- A. Coordinate features of distribution equipment and power monitoring and control components to form an integrated interconnection of compatible components.
  - 1. Match components and interconnections for optimum performance of specified functions.
- B. Coordinate Work of this Section with those in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

## **1.9 SOFTWARE SERVICE AGREEMENT**

- A. **Technical Support:** Beginning with Substantial Completion, provide software support for two years.
- B. **Upgrade Service:** Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include the operating systems. Upgrade shall include new or revised licenses for use of software.
  - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. **Manufacturers:** Provide the following to match Campus Standard
  - 1. Shark Meters (ENC-100B)

### **2.2 FUNCTIONAL DESCRIPTION**

- A. **Instrumentation and Recording Devices:** Monitor and record load profiles and chart energy consumption patterns.
  - 1. Calculate and Record the Following:
    - a. Load factor.



- b. Peak demand periods.
- 2. Measure and Record Metering Data for the Following:
  - a. Electricity.
- B. Power Quality Monitoring: Identify power system anomalies and measure, display, and record trends and alarms of the following power quality parameters:
  - 1. Voltage regulation and unbalance.
  - 2. Continuous three-phase rms voltage.
  - 3. Periodic max./min./avg. voltage samples.
  - 4. Harmonics.
  - 5. Voltage excursions.
  - 6.
- C. System: Report equipment status and power system control.

### **2.3 SYSTEM REQUIREMENTS**

- A. Monitoring and Control System: Include PC-based workstation, with its operating system and application software, connected to data transmission network.
- B. Surge Protection: For external wiring of each conductor entry connection to components to protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads.
  - 1. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Comply with requirements as recommended by manufacturer for type of line being protected.
- C. Addressable Devices: All transmitters and receivers shall communicate unique device identification and status reports to monitoring and control clients.
- D. BAS Interface: Provide factory-installed hardware and software to enable the BAS to monitor, display, and record data for use in processing reports.
  - 1. Hardwired Monitoring Points: Electrical power demand (kilowatts), electrical power consumption (kilowatt-hours), power factor.
  - 2. Modbus communication interface with the BAS shall enable the BAS operator to remotely monitor meter information from a BAS operator workstation. Control features and monitoring points displayed locally at metering panel shall be available through the BAS.

## **2.4 COMMUNICATION COMPONENTS AND NETWORKS**

- A. Network Configuration: High-speed, multi-access, open nonproprietary, industry standard communication protocol; LANs complying with EIA 485, 100 Base-T Ethernet, and Modbus TCP/IP.

## **2.5 POWER MONITORS**

- A. Separately mounted, permanently installed instrument for power monitoring and control, complying with UL 1244.
  - 1. Enclosure: NEMA 250, Type 1.
- B. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
  - 1. Indoor installation in non-air-conditioned spaces that have environmental controls to maintain ambient conditions of 0 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.
- C. rms Real-Time Measurements:
  - 1. Current: Each phase, neutral, average of three phases, percent unbalance.
  - 2. Voltage: Line-to-line each phase, line-to-line average of three phases, line-to-neutral each phase, line-to-neutral average of three phases, line-to-neutral percent unbalance.
  - 3. Power: Per phase and three-phase total.
  - 4. Reactive Power: Per phase and three-phase total.
  - 5. Apparent Power: Per phase and three-phase total.
  - 6. Power Factor: Per phase and three-phase total.
  - 7. Displacement Power Factor: Per phase and three-phase total.
  - 8. Frequency.
  - 9. THD: Current and voltage.
  - 10. Accumulated Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
  - 11. Incremental Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
  - 12. Conditional Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
- D. Demand Current Calculations, per Phase, Three-Phase Average and Neutral:
  - 1. Present.
  - 2. Running average.
  - 3. Last completed interval.
  - 4. Peak.
- E. Demand Real Power Calculations, Three-Phase Total:
  - 1. Present.
  - 2. Running average.
  - 3. Last completed interval.

4. Predicted.
  5. Peak.
  6. Coincident with peak kVA demand.
  7. Coincident with kVAR demand.
- F. Demand Reactive Power Calculations, Three-Phase Total:
1. Present.
  2. Running average.
  3. Last completed interval.
  4. Predicted.
  5. Peak.
  6. Coincident with peak kVA demand.
  7. Coincident with kVAR demand.
- G. Demand Apparent Power Calculations, Three-Phase Total:
1. Present.
  2. Running average.
  3. Last completed interval.
  4. Predicted.
  5. Peak.
  6. Coincident with peak kVA demand.
  7. Coincident with kVAR demand.
- H. Average Power Factor Calculations, Demand Coincident, Three-Phase Total:
1. Last completed interval.
  2. Coincident with kW peak.
  3. Coincident with kVAR peak.
  4. Coincident with kVA peak.
- I. Power Analysis Values:
1. THD, Voltage and Current: Per phase, three phase, and neutral.
  2. Displacement Power Factor: Per phase, three phase.
  3. Fundamental Voltage, Magnitude and Angle: Per phase.
  4. Fundamental Currents, Magnitude and Angle: Per phase.
  5. Fundamental Real Power: Per phase, three phase.
  6. Fundamental Reactive Power: Per phase.
  7. Harmonic Power: Per phase, three phase.
  8. Phase rotation.
  9. Unbalance: Current and voltage.
  10. Harmonic Magnitudes and Angles for Current and Voltages: Per phase, up to [31st] [63rd] <Insert number> harmonic.
- J. Power Demand Calculations: According to one of the following calculation methods, selectable by the user:

1. Thermal Demand: Sliding window updated every second for the present demand and at end of the interval for the last interval. Adjustable window that can be set in 1-minute intervals, from 1 to 60 minutes.
2. Block Interval with Optional Subintervals: Adjustable for 1-minute intervals, from 1 to 60 minutes. User-defined parameters for the following block intervals:
  - a. Sliding block that calculates demand every second, with intervals less than 15 minutes, and every 15 seconds with an interval between 15 and 60 minutes.
  - b. Fixed block that calculates demand at end of the interval.
  - c. Rolling block subinterval that calculates demand at end of each subinterval and displays it at end of the interval.
3. Demand Calculation Initiated by a Synchronization Signal:
  - a. Signal is a pulse from an external source. Demand period begins with every pulse. Calculation shall be configurable as either a block or rolling block calculation.
  - b. Signal is a communication signal. Calculation shall be configurable as either a block or rolling block calculation.
  - c. Demand can be synchronized with clock in the power meter.

K. Sampling:

1. Current and voltage shall be digitally sampled at a rate high enough to provide accuracy to 63rd harmonic of 60-Hz fundamental.
2. Power monitor shall provide continuous sampling at a rate of [128] <Insert number> samples per cycle on all voltage and current channels in the meter.

L. Minimum and Maximum Values: Record monthly minimum and maximum values, including date and time of record. For three-phase measurements, identify phase of recorded value. Record the following parameters:

1. Line-to-line voltage.
2. Line-to-neutral voltage.
3. Current per phase.
4. Line-to-line voltage unbalance.
5. Line-to-neutral voltage unbalance.
6. Power factor.
7. Displacement power factor.
8. Total power.
9. Total reactive power.
10. Total apparent power.
11. THD voltage L-L.
12. THD voltage L-N.
13. THD current.
14. Frequency.

M. Harmonic Calculation: Display and record the following:

1. Harmonic magnitudes and angles for each phase voltage and current through [31st] [63rd] <Insert number> harmonic. Calculate for all three phases, current and voltage,

and residual current. Current and voltage information for all phases shall be obtained simultaneously from same cycle.

2. Harmonic magnitude reported as a percentage of the fundamental or as a percentage of rms values, as selected by user.

N. Current and Voltage Ratings:

1. Designed for use with current inputs from standard instrument current transformers with 5-A secondary and shall have a metering range of 0-10 A.
2. Withstand ratings shall not be less than 15 A, continuous; 50 A, lasting over 10 seconds, no more frequently than once per hour; 500 A, lasting 1 second, no more frequently than once per hour.
3. Designed for use with voltage inputs from standard instrument potential transformers with a 120-V secondary.

O. Accuracy:

1. Comply with ANSI C12.20, Class 0.5; and IEC 60687, Class 0.5 for revenue meters. Accuracy from Light to Full Rating shall meet the following criteria:
  - a. Power: Accurate to 0.25 percent of reading, plus 0.025 percent of full scale.
  - b. Voltage and Current: Accurate to 0.075 percent of reading, plus 0.025 percent of full scale.
  - c. Power Factor: Plus or minus 0.002, from 0.5 leading to 0.5 lagging.
  - d. Frequency: Plus or minus 0.01 Hz at 45 to 67 Hz.
2. For meters that are circuit-breaker accessories, metering accuracy at full-scale shall not be less than the following:
  - a. Current: Plus or minus 2.5 percent.
  - b. Voltage: Plus or minus 1.5 percent.
  - c. Energy, Demand, and Power: Plus or minus 4.0 percent.
  - d. Frequency: Plus or minus 1 Hz.

P. Waveform Capture:

1. Capture and store steady-state waveforms of voltage and current channels; initiated manually. Each capture shall be for 3 cycles, 128 data points for each cycle, allowing resolution of harmonics to 31st harmonic of basic 60 Hz.
2. Store captured waveforms in internal nonvolatile memory; available for PC display, archiving, and analysis.

Q. Input: One digital input signal.

1. Normal mode for on/off signal.
2. Demand interval synchronization pulse, accepting a demand synchronization pulse from a utility demand meter.
3. Conditional energy signal to control conditional energy accumulation.

R. Outputs:

1. Operated either by user command sent via communication link, or set to operate in response to user-defined alarm or event.
2. Closed in either a momentary or latched mode as defined by user.
3. Each output relay used in a momentary contact mode shall have an independent timer that can be set by user.
4. One digital KY pulse to a user-definable increment of energy measurement. Output ratings shall be up to 120-V ac, 300-V dc, 50 mA, and provide 3500-V rms isolation.
5. One relay output module(s), providing a load voltage range from 20- to 240-V ac or from 20- to 30-V dc, supporting a load current of 2 A.
6. Output Relay Control:
  - a. Relay outputs shall operate either by user command sent via communication link or in response to user-defined alarm or event.
  - b. Normally open and normally closed contacts, field configured to operate as follows:
    - 1) Normal contact closure where contacts change state for as long as signal exists.
    - 2) Latched mode when contacts change state on receipts of a pickup signal; changed state is held until a dropout signal is received.
    - 3) Timed mode when contacts change state on receipt of a pickup signal; changed state is held for a preprogrammed duration.
    - 4) End of power demand interval when relay operates as synchronization pulse for other devices.
    - 5) Energy Pulse Output: Relay pulses quantities used for absolute kWh, absolute kVARh, kVAh, kWh In, kVARh In, kWh Out, and kVARh Out.
    - 6) Output controlled by multiple alarms using Boolean-type logic.

S. Onboard Data Logging:

1. Store logged data, alarms, events, and waveforms in 80 KB of onboard nonvolatile memory.
2. Default values for all logs shall be initially set at factory, with logging to begin on device power up.

T. Alarms.

1. User Options:
  - a. Define pickup, dropout, and delay.
  - b. Assign one of [four] <Insert number> severity levels to make it easier for user to respond to the most important events first.
  - c. Allow for combining up to [four] <Insert value> alarms using Boolean-type logic statements for outputting a single alarm.
2. Alarm Events:
  - a. Over/undercurrent.
  - b. Over/undervoltage.
  - c. Current imbalance.

- d. Phase loss, current.
  - e. Phase loss, voltage.
  - f. Voltage imbalance.
  - g. Over kW demand.
  - h. Phase reversal.
  - i. Digital input off/on.
  - j. End of incremental energy interval.
  - k. End of demand interval.
- U. Control Power: 90- to 457-V ac or 100- to 300-V dc.
- V. Communications:
- 1. Power monitor shall be permanently connected to communicate via RS-485 Modbus TCP/IP.
  - 2. Local plug-in connections shall be for RS-232 and 100 Base-T Ethernet.
- W. Display Monitor:
- 1. Backlighted LCD to display metered data with touch-screen selecting device.
  - 2. Touch-screen display shall be a minimum 12-inch diagonal, resolution of 800 by 600 RGB pixels, 256 colors; NEMA 250, Type 1 display enclosure.
  - 3. Display four values on one screen at same time.
    - a. Current, per phase rms, three-phase average and neutral.
    - b. Voltage, phase to phase, phase to neutral, and three-phase averages of phase to phase and phase to neutral.
    - c. Real power, per phase and three-phase total.
    - d. Reactive power, per phase and three-phase total.
    - e. Apparent power, per phase and three-phase total.
    - f. Power factor, per phase and three-phase total.
    - g. Frequency.
    - h. Demand current, per phase and three-phase average.
    - i. Demand real power, three-phase total.
    - j. Demand apparent power, three-phase total.
    - k. Accumulated energy (MWh and MVARh).
    - l. THD, current and voltage, per phase.
  - 4. Reset: Allow reset of the following parameters at the display:
    - a. Peak demand current.
    - b. Peak demand power (kW) and peak demand apparent power (kVA).
    - c. Energy (MWh) and reactive energy (MVARh).

## 2.6 LAN CABLES

- A. Comply with Section 271500 "Communications Horizontal Cabling."
- B. RS-485 Cable:

1. PVC-Jacketed, RS-485 Cable: Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, PVC insulation, unshielded, PVC jacket, and NFPA 70, Type CMG.
  2. Plenum-Type, RS-485 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and fluorinated-ethylene-propylene jacket, and NFPA 70, Type CMP.
- C. Unshielded Twisted Pair Cables: Category 6A as specified for horizontal cable for data service in Section 271500 "Communications Horizontal Cabling."

## **2.7 LOW-VOLTAGE WIRING**

- A. Low-Voltage Control Cable: Multiple conductor, color-coded, No. 20 AWG copper, minimum.
1. Sheath: PVC; except in plenum-type spaces, use sheath listed for plenums.
  2. Ordinary Switching Circuits: Three conductors unless otherwise indicated.
  3. Switching Circuits with Pilot Lights or Locator Feature: Five conductors unless otherwise indicated.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 CABLING**

- A. Comply with NECA 1.
- B. Install cables and wiring according to requirements in Section 271500 "Communications Horizontal Cabling."
- C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.
- D. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use NRTL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.



- E. Install LAN cables using techniques, practices, and methods that are consistent with specified category rating of components and that ensure specified category performance of completed and linked signal paths, end to end.
- F. Install cables without damaging conductors, shield, or jacket.

### **3.3 IDENTIFICATION**

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
- B. Label each power monitoring and control module with a unique designation.

### **3.4 GROUNDING**

- A. Comply with IEEE 1100, "Recommended Practice for Powering and Grounding Electronic Equipment."

### **3.5 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 inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. 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.
- D. Tests and Inspections:
  - 1. Electrical Tests: Use caution when testing devices containing solid-state components.
  - 2. Continuity tests of circuits.
  - 3. Operational Tests: Set and operate controls at workstation and at monitored and controlled devices to demonstrate their functions and capabilities. Use a methodical sequence that cues and reproduces actual operating functions as recommended by manufacturer. Submit sequences for approval. Note response to each test command and operation. Note time intervals between initiation of alarm conditions and registration of alarms at central-processing workstation.
    - a. Coordinate testing required by this Section with that required by Sections specifying equipment being monitored and controlled.
    - b. Test LANs according to requirements in Section 271500 "Communications Horizontal Cabling."

- c. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of calculated battery operating time.
  - d. Verify accuracy of graphic screens and icons.
  - e. Metering Test: Load feeders, measure loads on feeder conductor with an rms reading clamp-on ammeter, and simultaneously read indicated current on the same phase at central-processing workstation. Record and compare values measured at the two locations. Resolve discrepancies greater than 5 percent and record resolution method and results.
  - f. Record metered values, control settings, operations, cues, time intervals, and functional observations and submit test reports printed by workstation printer.
- E. Power monitoring and control equipment will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.
- H. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.
- I. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.
- J. Remove and replace malfunctioning devices and circuits and retest as specified above.

### 3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain systems. See Section 017900 "Demonstration and Training."
- 1. Train Owner's management and maintenance personnel in interpreting and using monitoring displays and in configuring and using software and reports. Include troubleshooting, servicing, adjusting, and maintaining equipment. Provide a minimum of 12 hours' training.
  - 2. Training Aid: Use approved final versions of software and maintenance manuals as training aids.

### 3.7 ON-SITE ASSISTANCE

- A. 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 **[three]** **<Insert number>** visits to Project during other-than-normal occupancy hours for this purpose.

**END OF SECTION 26 09 13**

## **SECTION 26 09 43 - NETWORK LIGHTING CONTROLS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. 265100 Interior Lighting

#### **1.2 SUMMARY**

- A. The lighting control system specified in this section shall provide time-based, sensor-based (both occupancy and daylight), and manual lighting control.
- B. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed)
- C. All system devices shall be networked together enabling digital communication and shall be individually addressable.
- D. The system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity even if network connectivity to the greater system is lost.
- E. The system architecture shall facilitate remote operation via a computer connection.
- F. The system shall not require any centrally hardwired switching equipment.
- G. The system shall be capable of wireless, wired, or hybrid wireless/wired architectures.

#### **1.3 SUBMITTALS**

- A. Product Datasheets (general device descriptions, dimensions, wiring details, nomenclature)
- B. Riser Diagrams – typical per room type (detailed drawings showing device interconnectivity of devices). All devices shall be indicated, and the devices shall be labeled per the room number they are located.
- C. Other Diagrams – as needed for special operation or interaction with other system(s)
- D. Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up
- E. Hardware and Software Operation Manuals
- F. Other operational descriptions as needed

#### **1.4 QUALITY ASSURANCE**

- A. All steps in sensor manufacturing process shall occur in the USA; including population of all electronic components on circuit boards, soldering, programming, wiring, and housing.
- B. All components and the manufacturing facility where product was manufactured must be ROHS compliant.
- C. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.
- D. All applicable products must be UL / CUL Listed or other acceptable national testing organization.

#### **1.5 COORDINATION**

- A. Coordinate lighting control components to form an integrated interconnection of compatible components.
- B. Coordinate lighting controls with BAS (if necessary) either through IP based intercommunication of system or hardwired auxiliary relay outputs.
- C. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

#### **1.6 WARRANTY**

- A. All devices in lighting control system shall have a 5 year warranty.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. This specification is based on the nLight® Network Control System from Sensor Switch, an Acuity Brands Company (800-727-7483, [www.sensorswitch.com](http://www.sensorswitch.com)). No alternates allowed since this is an LBCC Campus Standard.

#### **2.2 SYSTEM REQUIREMENTS**

- A. System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones 3) network backbone for remote or time-based operation.
- B. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch

stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.

- C. System must interface directly with intelligent LED luminaires such that only CAT-5 cabling is required to interconnect luminaires with control components such as sensors and switches (see Networked LED Luminaire section)
- D. Intelligent lighting control devices shall communicate digitally, require <4 mA of current to function (Graphic wall stations excluded), and possess RJ-45 style connectors.
- E. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.
- F. Devices within a lighting control zone shall be connected with CAT-5e low voltage cabling in any order.
- G. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.
- H. Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.
- I. Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, or from the network backbone. Standalone “bus power supplies” shall not be required in all cases.
- J. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in a remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.
- K. System shall have one or more primary wall mounted network control “gateway” devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN.
- L. System shall use “bridge” devices that route communication and distribute power for up to 8 directly connected lighting zones together for purposes of decreasing system wiring requirements.
- M. System shall be capable of wirelessly connecting a lighting zone to a WiFi (802.11n) wireless data network for purposes of eliminating the “bridge” devices and all cabling that connects zones to bridge devices.
- N. System shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control profiles.

- O. Individual lighting zones shall be capable of being segmented into several “local” channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.
- P. Devices located in different lighting zones shall be able to communicate occupancy, photocell, and switch information via either the wired or WiFi backbone.
- Q. System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week utilization of a space. Note operating modes should be utilized only in manners consistent with local energy codes.
  - 1. Auto-On / Auto-Off (via occupancy sensors)
    - a. Zones with occupancy sensors automatically turn lights on when occupant is detected.
    - b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
    - c. Pressing a switch will turn lights off. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.
  - 2. Manual-On / Auto-Off (also called Semi-Automatic)
    - a. Pushing a switch will turn lights on.
    - b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
  - 3. Manual-On to Auto-On/Auto-Off
    - a. Pushing a switch will turn lights on.
    - b. After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off according to occupancy/vacancy and/or daylight conditions.
    - c. Sequence can be reset via scheduled (ex. daily each morning) events
  - 4. Auto-to-Override On
    - a. Zones with occupancy sensors automatically turn lights on when occupant is detected.
    - b. Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
    - c. Sequence can be reset via scheduled (ex. daily each morning) events
  - 5. Manual-to-Override On
    - a. Pushing a switch will turn lights on.
    - b. Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
    - c. Sequence can be reset via scheduled (ex. daily each morning) events
  - 6. Auto On / Predictive Off
    - a. Zones with occupancy sensors automatically turn lights on when occupant is detected.

- b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
  - c. If switch is pressed, lights turn off and a short “exit timer” begins. After timer expires, sensor scans the room to detect whether occupant is still present. If no occupancy is detected, zone returns to auto-on. If occupancy is detected, lights must be turned on via the switch.
- R. A taskbar style desktop application shall be available for personal lighting control.
- S. An application that runs on “smart” handheld devices (such as an Apple® iPhone®) shall be available for personal lighting control.
- T. Control software shall enable logging of system performance data and presenting useful information in a web-based graphical format and downloadable to .CSV files.
- U. Control software shall enable integration with a BMS via BACnet IP.
- V. System shall provide the option of having pre-terminated plenum rated CAT-5 cabling supplied with hardware.

## 2.3 INDIVIDUAL DEVICE SPECIFICATIONS

- A. Control Module (Gateway)
- 1. Control module shall be a device that facilitates communication and time-based control of downstream network devices and linking into an Ethernet.
  - 2. Devices shall have a user interface that is capable of wall mounting, powered by low voltage, and have a touch screen.
  - 3. Control device shall have three RJ-45 ports for connection to other backbone devices (bridges) or directly to lighting control devices.
  - 4. Device shall automatically detect all devices downstream of it.
  - 5. Device shall have a standard and astronomical internal time clock.
  - 6. Device shall have one RJ-45 10/100 BaseT Ethernet connection.
  - 7. Device shall have a USB port
  - 8. Each control gateway device shall be capable of linking 1500 devices to the management software.
  - 9. Device shall be capable of using a dedicated or DHCP assigned IP address.
  - 10. Network Control Gateway device shall be the following Sensor Switch model Series:
    - a. nGWY2
- B. Networked System Occupancy Sensors
- 1. Occupancy sensors system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
  - 2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.

3. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional “dual” technology shall be used.
4. Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.
5. All sensing technologies shall be acoustically passive meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.
6. Sensors shall be available with zero, one, or two integrated Class 1 switching relays, and up to one 0-10 VDC dimming output. Sensors shall be capable of switching 120 / 277 / 347 VAC. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor. Relays shall be dry contacts.
7. Sensors shall be available with one or two occupancy “poles”, each of which provides a programmable time delay.
8. Sensors shall be available in multiple lens options which are customized for specific applications.
  - a. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
  - b. All sensors shall have two RJ-45 ports or capable of utilizing a splitter.
  - c. All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5 connections) and blink its LED in a pattern to visually indicate of a potential wiring issue
  - d. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.
  - e. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 cabling.
  - f. Sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements.
  - g. Network system shall have sensors that can be embedded into luminaire such that only the lens shows on luminaire face.
  - h. Network system shall also have ceiling, fixture, recessed, & corner mounted sensors available.
  - i. Fixture mount sensors shall be capable of powering themselves via a line power feed.
  - j. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.
  - k. Sensors with dimming can control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of Class 2 current (typically 40 or more ballasts).



- l. Sensors shall be the following Sensor Switch model numbers, with device options

Model # Series	Occupancy Poles	# of Relays	Lens Type	Detection Technology
nCM(B) 9	1	-	Standard	PIR
nCM(B) 9 2P	2	-	Standard	PIR
nCMR(B) 9	1	1	Standard	PIR
nCMR(B) 9 2P	2	2	Standard	PIR
nCM(B) PDT 9	1	-	Standard	Dual
nCM(B) PDT 9 2P	2	-	Standard	Dual
nCMR(B) PDT 9	1	1	Standard	Dual
nCMR(B) PDT 9 2P	2	2	Standard	Dual
nCM(B) 10	1	-	Extended	PIR
nCM(B) 10 2P	2	-	Extended	PIR
nCMR(B) 10	1	1	Extended	PIR
nCMR(B) 10 2P	2	2	Extended	PIR
nCM(B) PDT 10	1	-	Extended	Dual
nCM(B) PDT 10 2P	2	-	Extended	Dual
nCMR(B) PDT 10	1	1	Extended	Dual
nCMR(B) PDT 10 2P	2	2	Extended	Dual
nWV 16	1	-	Wide View	PIR
nWV PDT 16	1	-	Wide View	Dual
nHW13	1	-	Hallway	PIR
nCM(B) 6	1	-	High Bay	PIR
nCMR(B) 6	1	1	High Bay	PIR
nCMR(B) 6 2P	2	2	High Bay	PIR
nCMR(B) 6 480	1	2	High Bay	PIR

Note: Recessed mount versions of the above ceiling(fixture) mount versions also shall be available (e.g. nCMR(B) 9 => nRMR 9)

- m. System shall have WiFi enabled fixture mountable sensors available.  
n. Embedded sensors shall have an optional photocell and 0-10 VDC dimming

C. Networked System Daylight (Photocell and or Dimming) Sensors

1. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
2. Photocell and dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
3. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
4. Dimming sensors shall control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of class 2 current (typically 40 or more ballasts).

5. Photocell and dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the “auto set-point” setting.)
6. Combination units that have all features of on/off photocell and dimming sensors shall also be available.
7. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an “offset” from the primary zone.
8. Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching both 120 VAC, 277 VAC, and 347 VAC. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load. Relays shall be dry contacts.
9. Sensor shall be the following Sensor Switch model numbers, with device options as specified:
  - a. nCM(B) PC (on/off)
  - b. nCM(B) ADC (dimming)
  - c. nCM(B) PC ADC (on/off, 0-10 VDC dimming)
  - d. nCMR(B) PC (on/off, single relay)
  - e. nCMR(B) PC ADC (on/off, 0-10 VDC dimming, single relay)

Note: Recessed mount versions of the above ceiling(fixture) mount versions also shall be available (e.g. nCMR(B) PC => nRMR PC)

10. Network system shall have dimming photocells that can be embedded into luminaire such that only the lens shows on luminaire face.
11. Embedded sensors shall be the following Sensor Switch model number:
  - a. nES ADCX (Dimming Photocell)

**D. Networked System Power (Relay) Packs**

1. Power Pack shall incorporate one or more Class 1 relays and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay(s), shall have an optional 2nd relay, 0-10 VDC dimming output, or line voltage dimming output, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.
2. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC), be plenum rated, and provide Class 2 power to the system.
3. All devices shall have two RJ-45 ports.
4. Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.
5. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.

6. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
7. Power Packs and Power Supplies shall be available that are WiFi enabled.
8. Power (Secondary) Packs shall be available that provide up to 16 Amp switching of all lighting load types.
9. Power (Secondary) Packs shall be available that provide up to 5 Amps switching of all lighting load types as well as 0-10 VDC dimming or fluorescent ballasts/LED drivers.
10. Specific Secondary Packs shall be available that provide up to 5 Amps of switching as well as 0-10 VDC dimming of fluorescent ballasts/LED drivers.
11. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).
12. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120/277 VAC magnetic low voltage transformers.
13. Specific Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.
14. Specific Secondary Packs shall be available that provide up to 5 Amps of switching of dual phase (208/240/480 VAC) lighting loads.
15. Specific Secondary Packs shall be available that require a manual switch signal (via a networked Wall Station) in order to close its relay.
16. Specific Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits.
17. Specific Secondary Packs shall be available that control louver/damper motors for skylights.
18. Specific Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.
19. Power (Relay) Packs and Supplies shall be the following Sensor Switch model Series:
  - a. nPP16 (Power Pack w/ 16A relay)
  - b. nPP16 WIFI (Power Pack w/ 16A relay, WIFI enabled)
  - c. nEPP5 D (Power Pack w/ 5A relay and 0-10VDC dimming output)
  - d. nSP16 (Secondary Pack w/ 16A relay)
  - e. nSP5 2P (Secondary Pack w/ two 5A relays)
  - f. nSP5 D (Secondary Pack w/ 5A relay and 0-10VDC dimming output)
  - g. nPP16 ER (UL924 Listed Secondary Pack w/ 16A relay for switching emergency power circuits)
  - h. nSP5 D ER (UL924 Listed Secondary Pack w/ 5A relay and 0-10VDC dimming output for switching emergency power circuits)
  - i. nSP5 PCD 2W (Secondary Pack w/ 5A relay and incandescent dimming or 2-wire line voltage fluorescent dimming output)
  - j. nSP5 PCD 3W (Secondary Pack w/ 5A relay and 3-wire line voltage fluorescent dimming output)
  - k. nSP5 PCD MLV (Secondary Pack w/ 5A relay and magnetic low voltage dimming output)
  - l. nSP5 PCD ELV 120 (Secondary Pack w/ 4A relay and electronic low voltage dimming output)
  - m. nSP5 480 (Secondary Pack w/ 5A relay for switching 208/240/480 VAC loads)
  - n. nSP5 2P LVR (Louver/Damper Control Pack)
  - o. nSHADE (Pulse On/Off Control Pack)

- p. nPS 80 (Auxiliary Bus Power Supply)
- q. nPS 80 WIFI (Auxiliary Bus Power Supply, WiFi enabled)
- r. nAR 40 (Low voltage auxiliary relay pack)

E. Networked System Relay & Dimming Panels

1. Panel shall incorporate up to 4 normally closed latching relays capable of switching 120/277 VAC or up to 2 Dual Phase relays capable of switching 208/240/480 VAC loads.
2. Relays shall be rated to switch up to a 30A ballast load at 277 VAC.
3. Panel shall provide one 0-10VDC dimming output paired with each relay.
4. Panel shall power itself from an integrated 120/277 VAC supply.
5. Panel shall be capable of operating as either two networked devices or as one.
6. Panel shall supply current limited low voltage power to other networked devices connected via CAT-5.
7. Panel shall provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection
8. Power (Relay) Packs and Supplies shall be the following Sensor Switch model numbers:
  - a. nPANEL 4 (Panel w/ four 120/277 VAC relays and four 0-10 VDC dimming outputs)
  - b. nPANEL 2 480 (Panel w/ two dual phase relays (208/240/480 VAC) and two 0-10 VDC dimming outputs)

F. Networked Auxiliary Input / Output (I/O) Devices

1. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½” knockout.
2. Devices shall have two RJ-45 ports
3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
4. Specific I/O devices shall have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current (typically 40 or more ballasts).
5. Specific I/O devices shall have an input that read a 0-10 VDC signal from an external device.
6. Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event, run a local/remote control profile, or raise/lower a dimming output
7. Specific I/O devices shall sense state of low voltage outdoor photocells
8. Specific I/O devices shall enable RS-232 communication between lighting control system and Touch Screen based A/V control systems.
9. Specific I/O devices shall sense .
10. Auxiliary Input/Output Devices shall be the following Sensor Switch model numbers:
  - a. nIO D (I/O device with 0-10 dimming output)
  - b. nIO 1S or nIO RLX (I/O device with contact closure or 0-10VDC dimming input )
  - c. nIO NLI (Input device for detecting state of low voltage outdoor photocell; sold in nIO PC KIT only)
  - d. nIO X (Interface device for communicating with RS-232 enabled AV Touch Screens

G. Networked LED Luminaires

1. Networked LED luminaire shall have a mechanically integrated control device
2. Networked LED luminaire shall have two RJ-45 ports
3. Networked LED luminaire shall be able to digitally network directly to other network control devices (sensors, photocells, switches, dimmers)
4. Networked LED luminaire shall provide low voltage power to other networked control devices
5. System shall be able to turn on/off LED luminaire without using a relay
6. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by varying the input control power (and thus saving up to 20% power usage).
7. System shall indicate (via a blink warning) when the LED luminaire has reached its expected life (in hrs).
8. LED Luminaires shall be the following Lithonia model families:
  - a. RTLED
  - b. TLED
  - c. VLED
  - d. ACLED
  - e. AL LED
  - f. WLED
  - g. STLED
  - h. MINO

H. Networked System Wall Switches & Dimmers

1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
2. Devices shall be available with zero or one integrated Class 1 switching relay.
3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
4. All sensors shall have two RJ-45 ports.
5. All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.
6. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
7. Devices with dimming control outputs can control 0-10 VDC dimmable ballasts by sinking up to 20 mA of current (typically 40 or more ballasts).
8. Devices with capacitive touch buttons shall provide audible user feedback with different sounds for on/off, raise/lower, start-up, and communication offline.
9. Devices with mechanical push-buttons shall provide tactile and LED user feedback.
10. Devices with mechanical push-buttons shall be made available with custom button labeling
11. Devices with a single on button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.
12. Wall switches & dimmers shall be the following Sensor Switch model numbers, with device options as specified:
  - a. nPOD (single on/off, capacitive touch, audible user feedback)
  - b. nPOD 2P (dual on/off, capacitive touch, audible user feedback)

- c. nPODR (single on/off, one relay, capacitive touch, audible user feedback)
- d. nPODM (single on/off, push-buttons, LED user feedback)
- e. nPODM 2P (dual on/off, push-buttons, LED user feedback)
- f. nPODM DX (single on/off, single dimming raise/lower, push-buttons, LED user feedback)
- g. nPODM 2P DX (dual on/off, dual dimming raise/lower, push-buttons, LED user feedback)
- h. nPODM 4P (quad on/off, push-buttons, LED user feedback)
- i. nPODM 4P DX (quad on/off, quad dimming raise-lower, push-buttons, LED user feedback)

**I. Networked System Graphic Wall Station**

- 1. Device shall have a 3.5" full color touch screen for selecting up to 8 programmable lighting control presets or acting as up to 16 on/off/dim control switches.
- 2. Device shall enable configuration of lighting presets, switched, and dimmers via password protected setup screens.
- 3. Device shall enable user supplied .jpg screen saver image to be uploaded.
- 4. Device shall surface mount to single-gang switch box
- 5. Device shall have a micro-USB style connector for local computer connectivity.
- 6. Device shall have two RJ-45 ports for communication
- 7. Device shall be the following Sensor Switch model number:

- a. nPOD GFX

**J. Networked System Scene Controllers**

- 1. Device shall have two to four buttons for selecting programmable lighting control profiles or acting as on/off switches.
- 2. Device shall recess into single-gang switch box and fit a standard GFI opening.
- 3. Devices shall provide LED user feedback.
- 4. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
- 5. All sensors shall have two RJ-45 ports.
- 6. Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.
- 7. Device shall be capable of selecting a lighting profile be run by the system's upstream Gateway so as to implement selected lighting profile across multiple zones (and not just its local zone).
- 8. Device shall have LEDs indicating current selection.
- 9. Scene Selector device shall be the following Sensor Switch model number:

- a. nPODM 2S (2 Scene, push-button)
- b. nPODM 4S (4 Scene, push-button)
- c. nPODM 4S DX (4 Scene, push-button, On/Off/Raise/Lower)
- d. nPODM 4L DX (4 Adjustable Presets, push-button, On/Off/Raise/Lower)

**K. Communication Bridges**

- 1. Device shall surface mount to a standard 4" x 4" square junction box.

2. Device shall have 8 RJ-45 ports.
3. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to Control Gateway.
4. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5 cabled connection.
5. Device shall be careful of redistributing power from its local supply and connect lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.
6. Communication Bridge devices shall be the following Sensor Switch model numbers:
  - a. nBRG 8 (8 Ports)

## **2.4 LIGHTING CONTROL PROFILES**

- A. Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.
- B. Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.
- C. All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.
- D. Every device parameter (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.
- E. All lighting control profiles shall be stored on the network control gateway device and on the software's host server.
- F. Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.
- G. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
- H. Daylight savings time adjustments shall be capable of being performed automatically, if desired.
- I. Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.
- J. Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

## **2.5 MANAGEMENT SOFTWARE**

- A. Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software
- B. The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).
- C. The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.
- D. A printable network inventory report shall be available via the software.
- E. A printable report detailing all system profiles shall be available via the software.
- F. Software shall require all users to login with a User Name and Password.
- G. Software shall provide at least three permission levels for users.
- H. All sensitive stored information and privileged communication by the software shall be encrypted.
- I. All device firmware and system software updates must be available for automatic download and installation via the internet.
- J. Software shall be capable of managing systems interconnected via a WAN (wide area network)

## **2.6 BMS COMPATIBILITY**

- A. System shall provide a BACnet IP gateway as a downloadable software plug-in to its management software. No additional hardware shall be required.
- B. BACnet IP gateway software shall communicate information gathered by networked system to other building management systems.
- C. BACnet IP gateway software shall translate and forward lighting relay and other select control commands from BMS system to networked control devices.
- D. Product: nLight #nBACnet

## **2.7 SYSTEM ENERGY ANALYSIS & REPORTING SOFTWARE**

- A. System shall be capable of reporting lighting system events and performance data back to the management software for display and analysis.



- B. Intuitive graphical screens shall be displayed in order to facilitate simple viewing of system energy performance.
- C. An “Energy Scorecard” shall be display that shows calculated energy savings in dollars, KWHr, or CO2.
- D. Software shall calculate the allocation of energy savings to different control measures (occupancy sensors, photocells, manual switching, etc).
- E. Energy savings data shall be calculated for the system as a whole or for individual zones.
- F. A time scaled graph showing all relay transitions shall be presented.
- G. A time scaled graph showing a zones occupancy time delay shall be presented
- H. A time scaled graph showing the total light level shall be presented.
- I. User shall be able to customize the baseline run-time hours for a space.
- J. User shall be able to customize up to four time-of-day billing rates and schedules.
- K. Data shall be made available via a .CSV file

### **PART 3 - EXECUTION**

#### **3.1 START-UP & SUPPORT FEATURES**

- A. To facilitate start-up, all devices daisy-chained together (using CAT-5) shall automatically be grouped together into a functional lighting control zone.
- B. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.
- C. Once software is installed, system shall be able to auto-discover all system devices without requiring any commissioning.
- D. All system devices shall be capable of being given user defined names.
- E. All devices within the network shall be able to have their firmware reprogrammed remotely and without being physically uninstalled for purposes of upgrading functionality at a later date.
- F. All sensor devices shall have the ability to detect improper communication wiring and blink its LED in a specific cadence as to alert installation/startup personnel.
- G. The manufacturer is required to have a factory authorized representative field verify and commission the installation. The field visit shall be at minimum 3 days time for each commissioning visit. The manufacturer representative shall include appropriate time to allow for repeat visits as required for a fully functional system.

- H. Coordinate operation of zones as indicated on plans with controls contractor for proper integration with BMS.

**END OF SECTION 26 09 23**

## SECTION 26 22 00 - 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. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
  - 1. Distribution transformers.
  - 2. Buck-boost transformers.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical data including rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated. Include manufacturer's product data for each type of transformer and for each size specified. Highlight clearly specific information applicable to the project. Submittals with general catalogs will not be accepted and reviewed.
  - 1. K.V.A. and voltage of primary and secondary windings.
  - 2. Windings insulation class and rates temperature rise.
  - 3. Underwriters' Laboratories, Inc. (U.L.) label.
  - 4. Sound level test results of a similar transformer.
  - 5. Physical size and finish.
  - 6. Efficiency at 25, 50, 75 and 100 percent rated load.
  - 7. Windings material.
  - 8. Factory test report of ratio and polarity test.
  - 9. Factory test report of applied voltage test.
  - 10. Factory test report of induced voltage test.
  - 11. Factory test report of temperature rise at full load.
  - 12. Impedance rating and characteristics.
- 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, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - 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."
  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 test reports.
- D. Field quality-control test 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. If alternate manufacturer of products other than what are specified in this section are submitted, all necessary documents not limited to cut sheets, technical information, test reports from recognized testing labs and factory test reports shall be submitted to the satisfaction of the owner/engineer to ensure quality and conformance to the specifications. Additional testing shall be undertaken if it is concluded by the owner/engineer that the submitted test reports are either insufficient or do not include all tests necessary for product acceptance. The tests shall be conducted by a recognized lab acceptable to the owner/engineer and all tests shall be witnessed by owner's/engineer's personnel. All testing procedures and test results shall be satisfactory to the owner/engineer. Contractor shall be responsible for arranging the tests, for transportation, food and lodging for minimum of one owner's/engineer's representative to witness the test at the testing lab. Include all costs for the above in the bid.
- B. Contractor shall ensure that the manufacturer has a minimum of 15 years experience in the production of low voltage transformers to the type and size specified in this project.

- C. Manufacturer shall have ISO 9001 Certification.
- D. Manufacturer shall have ability to readily provide replacement parts for a minimum period of ten (10) years, from the date of completion of the project
- E. Transformer shall be assembled at the manufacturer's own manufacturing facility using its own major devices (e.g. transformer core, windings etc.) for the assembly.
- F. Materials and equipment shall be new, modern in design and shall not have been in prior service except as required by factory tests. Major components (e.g., primary switch, transformer, and switchboard) shall be manufactured within six months of installation.
- G. Source Limitations: Obtain transformers through one source from a single manufacturer through a local distributor. All power distribution equipment shall be of the same manufacturer as the substation.
- H. Comply with NFPA 70.
- I. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- J. Product Options: Drawings indicate size, profiles, and dimensional requirements of secondary unit substations and are based on the specific system indicated. Refer to Part 2 "Product Requirements."
- K. Electrical Components, Devices and Accessories: UL Listed and labeled as defined in NFPA 70, Article 100 and marked for intended use.
- L. Testing Agency Qualifications:
  - 1. Testing agency shall be an independent company with the experience to conduct field testing as indicated; shall have been a member of Inter-National Testing Association (NETA) for a minimum of last ten (10) years.
  - 2. The company shall have permanent in-house testing engineers and technicians.
  - 3. Testing company shall be located with 50 miles radius of the project.
  - 4. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing to supervise on-site testing specified in Part 3.
  - 5. Field Testing technician and supervisor shall have minimum ten (10) years' experience in field testing of unit substations similar to the type and rating specified on this project.
- M. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

## **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.

## 1.8 COORDINATION

- A. 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.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Square D; Schneider Electric.
  - 2. Eaton Electrical Inc.; Cutler-Hammer Products.
  - 3. General Electric Company.
  - 4. Siemens Energy & Automation, Inc.

### 2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: High grade, non-aging, grain-oriented, non-aging silicon steel. l with high magnetic permeability, and low hysteresis and eddy current losses. The core of the transformer shall be visibly grounded to the enclosure by means of flexible grounding conductor sized in accordance with applicable UL and NEC standard.
- C. Coils: Continuous windings without splices except for taps.
  - 1. Internal Coil Connections: Brazed or pressure type.
  - 2. Coil material: Copper. Basic Insulation Level (BIL) for all 600V class windings shall be 10KV.

### 2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Provide transformers that are constructed to withstand seismic forces specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- C. Cores: One leg per phase.
- D. Enclosure: Ventilated, NEMA 250, Type 3R.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
  2. Shall be fabricated of heavy gauge, sheet steel construction.
  3. All ventilated openings shall be protected against falling dirt.
  4. Ventilated, raintight, NEMA 250, Type 3R, stainless steel. Provide suitable weather shields over ventilation openings.
  5. Provide rodent screen on front opening of the transformer.
- E. Transformer Enclosure Finish: Comply with NEMA 250.
1. Finish Color: ANSI 49 gray. The enclosure shall be finished utilizing a continuous process of degreasing, cleaning and phosphatizing followed by electrostatic deposition of polyester powder coating and baking.
- ~~F.~~ Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- G. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature. The maximum temperature of the top of the enclosure shall not exceed 50°C rise above a 40°C ambient.
- H. Energy Efficiency for Transformers Rated 15 kVA and Larger:
1. Comply with DOE 10 CFR Part 431 Appendix A of Subpart K 2016.
  2. Energy efficiency under DOE 2016 requirements is to be Energy Verified by UL.
- I. 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. K factor shall not exceed 4, 13 or 20. K factor shall be as listed on the drawings.
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.
- J. 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.
  3. Shield Effectiveness:
    - a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
    - b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
    - c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.
- K. Wall Brackets: Manufacturer's standard brackets.

- L. Fungus Proofing: Permanent fungicidal treatment for coil and core.
- M. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.
- N. Low-Sound-Level Requirements: Maximum sound levels, when factory tested according to IEEE C57.12.91, as follows:
  - 1. 51 to 150 kVA: 50.
  - 2. 151 to 300 kVA: 55.
  - 3. 301 to 500 kVA: 60.

## **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 comply with NEMA ST 1 and shall be listed and labeled as complying with UL 506 or UL 1561.
- B. Enclosure: Ventilated, NEMA 250, Type 2.
  - 1. Finish Color: ANSI 49 gray.

## **2.5 IDENTIFICATION DEVICES**

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each [**distribution**] [**buck-boost**] transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

## **2.6 SOURCE QUALITY CONTROL**

- A. Test and inspect transformers according to IEEE C57.12.91 at the factory prior to shipping to job site.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.
- C. Prepare and submit test report indicating actual test data within two (2) weeks of completion of tests prior to shipping to job site. Test report shall be signed by the factory test technician or engineer and include comments by the testing engineer or supervisor. Include their name, date and location

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.



- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
  - 1. Brace wall-mounting transformers as specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
- C. Transformers shall be installed at least six (6) inches from the adjacent wall or structure unless otherwise required by the manufacturer. Verify with manufacturer's installation instructions before start of work.
- D. All conduits shall be isolated from the transformer enclosures by the use of neoprene grommets at conduit entrances to enclosure and the use of a grounding bushing. Flexible jumpers shall be installed for grounding continuity from enclosure to conduits or bus ducts.
- E. Where primary feeders come from the floor below, they shall terminate at the end of transformer enclosure with a metal grounding bushing with neoprene throat insert. Ground the bushing to the transformer enclosure.
- F. Where primary feeders come from overhead, the conduits shall enter the side of the transformer enclosure. The conduits within 36 inches of the enclosure shall be flexible steel.
- G. Where transformers are installed next to an indoor switchboard, secondary conductors shall be routed from transformer to secondary switchboard through a 12-inch long wiring gutter, flanged and bolted to transformer enclosure and switchboard enclosure. Install a neoprene gasket between gutter and transformer enclosure and bond gutter to transformer enclosure with a flexible copper grounding strap.

### **3.3 CONNECTIONS**

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### **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. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
  - 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. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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 2 follow-up infrared scans of transformers, one at 4 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 10 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 26 22 00**

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January 10, 2022  
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**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

## SECTION 26 24 13 - SWITCHBOARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Furnish, install and connect main switchboard, including metering facilities as required by utility company.
2. Main switchboards shall be complete with pull, service, and distribution sections.
3. Protective devices in main switchboard shall be furnished with a minimum symmetrical short-circuit interrupting rating, as provided by electric utility company.
4. Provide installation detail and seismic anchorage notes for switchboards.

### PART 2 - PRODUCTS

#### 2.1 SWITCHBOARDS

A. General Description: Switchboards shall be product of Square D, Cuttler Hammer, General Electric, or equal, and shall conform to the following requirements:

1. Complete assembly, including steel framing and covers, bus system, and breaker mounting, shall satisfy applicable provisions of UL 891 and NEMA PB-2 and the California Electrical Code for low-voltage distribution switchboards. Switchboards shall be furnished with UL labels.
2. Switchboards shall be floor standing, dead front, dead rear, line bussed, front operated and connected, circuit-breaker type, unless otherwise indicated and shall contain equipment indicated and specified. Switchboard shall be complete with pull, service, and distribution sections as required.
3. Required equipment shall be enclosed in fully interchangeable die formed steel sectional cabinets with top and bottom plates and required braces and gussets so that cabinets will be absolutely rigid, plumb and uniform in size. Each cabinet shall be a separate and independent unit with assembly holes die-stamped or jig drilled; openings for interconnections shall be so placed that any cabinet can be located in any position in assembly without drilling or cutting holes on job. Deliver switchboard to Project site in completely assembled sections and provide required assembly bolts and blanking plates. Front plates and doors shall be of not less than 12 gage furniture steel, completely removable, secured to cabinet with machine screws, with cup washers uniformly and symmetrically spaced. Provide hinged wire gutter covers for distribution sections. Equipment shall meet NEMA and UL standards.
4. Main circuit breaker or main fusible switch shall be as follows:
  - a. Main circuit breakers shall be automatic, one-piece molded-case, trip-free, common trip, quick-make, quick-break, thermal-magnetic with solid state trips,

- bolted to bus with frame size and trip ratings as indicated on drawings. Voltage, amperage ratings and number of poles shall be as indicated on breakers. Main breaker shall provide a minimum short-circuit interrupting capacity as determined by utility company. Provide shunt-trip and integral ground fault devices, as indicated on drawings. Breakers shall be furnished with lockout provisions.
- b. Main fusible switch 800 amps or larger ampacity shall be high pressure contact, stored energy, quick-make/quick-break operation, with current limiting fuses, as indicated on Drawings. Provide shunt-trip, and integral ground fault devices, as indicated on Drawings. Were required, switches shall be motor operated and be furnished with an electrical trip mechanism piloted by output of ground fault sensing circuitry. Switch shall be furnished with lockout provisions.
5. Feeder circuit breakers shall be automatic, one-piece molded-case, trip-free, common trip, quick-make, quick-break, thermal-magnetic or solid state type bolted to bus, with handles clearly indicating tripped position. Breakers shall be furnished with a single handle with no tie-bar. Voltage, amperage, and number of poles shall be as indicated on Drawings. Breaker ratings shall be on handle or label. Breakers shall be furnished with lockout provisions approved by the State of California for padlocking and shall provide a minimum symmetrical short-circuit interrupting rating, as indicated on Drawings. Series rated circuit breaker combinations are not acceptable.
  6. Fusible feeder switches shall be quick-make, quick-break, voltage rating and number of poles as indicated on Drawings, with visible blades and dual horsepower ratings. Switch handles shall physically indicate on and off positions. Switches shall be lockable only in off position and accept 3 industrial type heavy-duty padlocks. Switch covers and handles shall be interlocked to prevent opening in on position. Provide means to permit authorized personnel to release interlock for inspection purposes. Switches shall be equipped with Class R current limiting fuses or dual element fuse of size and capacity indicated on Drawings.
  7. Utility metering provisions shall meet requirements of serving utility and shall be furnished with necessary fittings.
  8. Provide for all switchboard silver-plated copper bus bars of same capacity as main breaker, or as indicated on Drawings, between current transformer and main section and distribution sections; also, full height of breaker space in distribution portions. Copper bus shall have current density of 1000A per square inch of cross section. Bus structure shall be free-fitted, and shall have sufficient strength to withstand short-circuit as indicated on drawings. Connections shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade 5 machine screws secured with constant pressure-type locking devices. Bus bar bracing shall be designed to withstand maximum available short-circuit current. Connections for cables to all circuit breakers, switches and motor control devices shall be heavy-duty mechanical pressure type terminal lugs. Provide service cable lugs as required by utility company. Cables and internal wiring shall be supported with suitable cleats.
  9. Switchboard distribution sections shall be furnished with full height bussing. Unused spaces shall be provided with blank covers. Switchboards, as complete units, shall be given single short-circuit current ratings by manufacturer. Such ratings shall be established by actual tests by manufacturer, in accordance with UL specifications, on equipment constructed similarly to the furnished switchboard.
  10. Provide nameplates for components on switchboards. Plates shall be black and white plastic nameplate stock, with characters cut through black exposing white, and shall bear designation of service, or feeders controlled and fuse size. Provide similar nameplates

for meter and transformer compartments. A large nameplate identifying switchboard, indicating service voltage, function and current rating shall be furnished with 3/16 inch engraved block letters.

11. Paint cabinets, framework and plates inside and out with one coat of rust-resistant metal primer and one coat of gray enamel, baked on, or lacquer sprayed on.
12. Manufacture boards according to reviewed Shop Drawings. Switchboard shall meet requirements of legally constituted authorities having jurisdiction, and respective serving utility.
13. Switchboards installed outdoors shall be weatherproof NEMA Type 3R enclosure. Enclosure construction shall be formed of code gage galvanized steel with ANSI No. 61 gray enamel finish. Heavy-duty, 3-point latching, vault type door handles with padlocking provisions shall be furnished on doors. Padlocks shall be furnished keyed to Corbin No. 60 keys. Switchboards installed outdoors shall be specifically required to maintain service during extreme outdoor ambient temperatures of a minimum of 150 degrees Fahrenheit in NEMA Type 3R enclosures.
14. For grounded wye electrical service switchboards rated more than 150 volts, to ground and 1,000 amperes or more, provide ground fault protection for main protective device. Ground fault protection shall be UL listed, with ground sensor encircling all phase conductors and neutral conductors integral with the main protective device. Provide testing of ground fault protection system by an independent recognized testing laboratory. Testing lab shall provide necessary testing equipment at the Project site and perform a certified test on ground protection system in presence of the IOR. The ground fault setting shall be selected to coordinate with downstream circuit protective devices. Verify that the system neutral is grounded at the service entrance switchboard only, except neutrals of step down distribution transformers. For branch circuit protective devices, rated 800 amps or more, provide ground fault protection where shown on the drawings, or as described above, for main protective device. Coordinate settings with main protective device ground fault protection.
15. In main and distribution switchboards provide a multifunctional digital meter with true RMS measured Amperes (each phase and neutral) Volts (line-to-line and line-to-neutral), Power Factor, Frequency, VA, VAR, Watts, KWH, KVARH, KVAH, voltage/current unbalance, and demand metering: W, VAR, Amperes, VA. Meter to have a front mounted RS232 port to allow programming and meter values via laptop computer and supplied software. The meter shall be equal to GE Multiline PQM.
16. Connections to any bussing shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade 5 machine screws secured with constant pressure-type locking devices.
17. Digital energy meter, DEM 2000 series by Siemens shall be provided and connected to building energy management system.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Switchboards shall be located so that they are readily accessible and not exposed to physical damage.

- B. Switchboard locations shall provide sufficient working space around the switchboard to comply with the California Electrical Code.
- C. Switchboards shall be securely fastened to the mounting surface.
- D. Switchboard cabinets shall be grounded as specified in Article 250 of the California Electrical Code.
- E. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the enclosure.
- F. Lugs shall be suitable and as required for installation with the conductor being connected.
- G. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- H. Maintain the required bending radius of conductors inside the cabinet.
- I. Distribute and arrange conductors neatly in the wiring gutters.
- J. Tightening the wire lugs or any conductor connections shall be performed in the presence of the IOR. Torque values shall be those recommended by manufacturer.
- K. Remove shipping blocks from component devices.
- L. Manually exercise circuit breakers to verify they operate freely.
- M. Remove debris from switchboard interior.
- N. Follow manufacturer's instructions for installation.
- O. Furnish one spare fuse for each fusible switch installed. Spare fuses shall be of the same type and rated as those installed.
- P. Do not install in highly corrosive environments such as pool equipment, boiler, chemical and corrosive materials storage rooms, and similar areas. When equipment is installed in such areas, it shall be labeled and listed for the application.

### **3.2 PADS AND ANCHORING**

- A. Where free-standing equipment is installed at exterior locations or in locations below grade, concrete pads shall be provided as specified in Section 033000: Cast-In-Place Concrete.
- B. Where a utility meter is installed in a switchboard, concrete pad shall extend 3 feet from face of switchboard door or board, whichever is greater. Concrete pad installation shall comply with electric utility company requirements.



- C. Anchor bolts for freestanding equipment shall meet California seismic zone 4 requirements, and manufacturer's installation recommendations. The more stringent requirements will be enforced.

**END OF SECTION 26 24 13**

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January 10, 2022  
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**Long Beach City College**  
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Long Beach, California

## **SECTION 26 24 16 - 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.
- B. Related Sections include the following:
  - 1. Section 260553 "Identification for Electrical Systems".
  - 2. Section 260573 "Overcurrent Protective Device Coordination Study" for short-circuit rating of devices and for setting of overcurrent protective devices.

#### **1.3 DEFINITIONS**

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. RMS: Root mean square.
- D. SPDT: Single pole, double throw
- E. SPD: Surge Protective Device
- F. SVR: Suppressed voltage rating.
- G. TVSS: Transient voltage surge suppressor.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the latest California Building Code (CBC) with OSHPD Amendments.

## **1.5 ACTION SUBMITTALS**

- A. **Product Data:** For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. 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. Show tabulations of installed devices, equipment features, and ratings.
  2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  3. Detail bus configuration, current, and voltage ratings.
  4. Short-circuit current rating of panelboards and overcurrent protective devices.
  5. Include evidence of UL listing for series rating of installed devices. Series rated devices shall be permitted if specified on the drawings.
  6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  7. Include wiring diagrams for power, signal, and control wiring.
  8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.

## **1.6 INFORMATIONAL SUBMITTALS**

- A. **Qualification Data:** For qualified testing agency.
- B. **Seismic Qualification Certificates:** Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:
  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.
4. Submit within two (2) weeks of completion of tests.

D. Panelboard Schedules: For installation in panelboards.

## 1.7 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 017823 "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.

## 1.8 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 Ground Fault Equipment Protection (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.

## 1.9 QUALITY ASSURANCE

- A. If alternate manufacturer of products other than what are specified in this section are submitted, all necessary documents not limited to cut sheets, technical information, test reports from recognized testing labs and factory test reports shall be submitted to the satisfaction of the owner/engineer to ensure quality and conformance to the specifications. Additional testing shall be undertaken if it is concluded by the owner/engineer that the submitted test reports are either insufficient or do not include all tests necessary for product acceptance. The tests shall be conducted by a recognized lab acceptable to the owner/engineer and all tests shall be witnessed by owner's/engineer's personnel. All testing procedures and test results shall be satisfactory to the owner/engineer. Contractor shall be responsible for arranging the tests, for transportation, food and lodging for minimum of one owner's/engineer's representative to witness the test at the testing lab. Include all costs for the above in the bid.

- B. Contractor shall ensure that the manufacturer has a minimum of 15 years experience in the production of Panelboards similar to the type and size specified in this project.
- C. Manufacturer shall have ISO 9001 or 9002 Certification.
- D. Manufacturer shall have ability to readily provide replacement parts for a minimum period of ten (10) years, from the date of completion of the project. Furnish a letter from the manufacturer confirming the availability.
- E. Panelboards shall be assembled at the manufacturer's own manufacturing facility using its own major devices (e.g., circuit breakers) for the assembly. These devices shall be normally carried by the manufacturer as standard catalog items.
- F. Panelboard shall comply with seismic zone applicable to the project. Unless otherwise indicated, verify requirements with Architect or Structural Engineer of Record (SEOR). Provide certified test reports of shake table test done by manufacturer on similar units as applicable for OSHPD projects.
- G. Materials and equipment shall be new, modern in design and shall not have been in prior service except as required by factory tests. Major components (e.g. Circuit breakers) shall be manufactured within six months of installation.
- H. Source Limitations: Obtain panelboards, overcurrent protective devices and accessories through one source from a single manufacturer through a local distributor unless otherwise indicated. All power distribution equipment shall be of the same manufacturer as the substation.
- I. Comply with NFPA 70.
- J. Comply with NEMA PB 1.
- K. Comply with UL 891.
- L. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- M. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Part 2 "Product Requirements."
- N. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in NFPA 70, Article 100—and marked for intended location and application.
- O. Testing Agency Qualifications: Member of NETA;
  - 1. Testing agency shall be an independent company; shall have been a member of NETA for a minimum of ten (10) years and has permanent in-house testing engineers and technicians involved with testing of switchboards, panelboards and OCPDs similar to those specified on this project.
  - 2. Testing company shall be located with 50 miles radius of the project.

3. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing to supervise on-site testing specified in Part 3.
4. Field Testing technician and supervisor shall have minimum ten (10) years experience in field testing of switchboards similar to the type and rating specified on this project.

#### **1.10 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.

#### **1.11 PROJECT 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 (minus 30 deg C) to plus 104 deg F (plus 40 deg C).
    - b. Altitude: Not exceeding 6600 feet (2000 m).
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  1. Ambient temperatures within limits specified.
  2. Altitude not exceeding 6600 feet (2000 m).
- 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 and Owner no fewer than fourteen days in advance of proposed interruption of electric service.
  2. Do not proceed with interruption of electric service without Architect's and Owner's written permission.
  3. Comply with NFPA 70E.

#### **1.12 COORDINATION**

- 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. 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.

### 1.13 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression 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 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted 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. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    - d. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5.
  - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
  - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
  - 4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor. No splices shall be permitted inside the skirt.
  - 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections. No splices shall be permitted inside gutters.
  - 6. Finishes:



- a. Panels and Trim: Steel factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
  - b. Back Boxes: Galvanized steel.
7. Directory Card: Inside panelboard door, mounted in transparent card holder.
- C. Incoming Mains Location: Top and bottom.
- D. Phase, Neutral, and Ground Buses:
1. Material: Tin-plated aluminum.
  2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
  4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
  5. Split Bus: Vertical buses divided into individual vertical sections.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Tin-plated aluminum.
  2. Main and Neutral Lugs: Mechanical type.
  3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
  4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- F. Service Equipment Label: UL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard shall be listed and labeled with UL short circuit rating. If Series Rated Panelboard is specified-the panelboard shall be rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by UL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by UL.
- I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

## 2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers
1. Square D; a brand of Schneider Electric
  2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  4. Siemens Energy & Automation, Inc.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Interiors shall be completely factory assembled. These shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus interiors.
- D. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- E. Mains: Circuit breaker.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- G. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- H. Branch Overcurrent Protective Devices: Fused switches.
- I. Where indicated, provide circuit breakers UL listed for application at 100% of their continuous ampere rating in their intended enclosure.
- J. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
  2. External Control-Power Source: 120-V branch circuit.
- K. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

## 2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

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

1. Square D; a brand of Schneider Electric
  2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  4. Siemens Energy & Automation, Inc.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Door-in-door type. Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

## 2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
1. Square D; a brand of Schneider Electric
  2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  4. Siemens Energy & Automation, Inc..
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Where indicated provide circuit breakers UL listed for application at 100% of their continuous ampere rating in their intended enclosure.
  2. Thermal-Magnetic Circuit Breakers (below 400A frame): Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Provide field adjustable magnetic trip setting for circuit-breakers serving motor loads or other special applications as indicated
  3. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  4. Electronic trip circuit breakers (400A frame size and larger) 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 time adjustments.
    - d. Ground-fault pickup level, time delay, and  $I^2t$  response.

- e. CBs shall have an integral power supply installed at the factory if required for proper functioning of the breaker. An external power supply shall not be acceptable.
5. Circuit breakers shall have a minimum interrupting rating of 10,000 amperes RMS symmetrical at 240 volts, and 14,000 amperes RMS symmetrical at 480 volts, unless otherwise noted on the drawings. Verify maximum available fault levels from the Short Circuit and Coordination Study. Minimum interrupting rating (AIC) shall be 110% of the available fault level.
6. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
7. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
8. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
9. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
10. Molded-Case Circuit-Breaker (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 materials.
  - 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. Shunt Trip: Trip coil energized from separate circuit, set to trip at [55] [75] percent of rated voltage.
  - f. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
  - g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
  - h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
  - i. Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.
- C. 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 262813 "Fuses."
  2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
  3. Auxiliary Contacts: One normally open and normally closed contact(s) that operate with switch handle operation.

## **2.5 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. Receive, inspect, handle, and store panelboards according to NECA 407.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install panelboards and accessories according to NECA 407.
- B. Equipment Mounting: Install panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
  - 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to panelboards.
  - 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

- E. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated. Mounting height of Over Current Protective Devices shall be 6"7" above finished floor to the center of the grip of device operating handle unless a lower height is indicated or required by code.
- F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
- H. Install filler plates in unused spaces.
- I. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- J. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- K. Comply with NECA 1.

### **3.3 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### **3.4 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 inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. 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.
- D. Acceptance Testing Preparation:
1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  2. Test continuity of each circuit.
- E. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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.
- F. Panelboards will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### **3.5 ADJUSTING**

- A. Adjust moving parts and operable component to function smoothly and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "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.
  1. Measure as directed during period of normal system loading.

2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

### **3.6 PROTECTION**

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

**END OF SECTION 26 24 16**



## SECTION 26 27 26 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Provide wiring devices as specified.

#### 1.2 REFERENCES

- A. References include the following:
1. NEMA WD 1 - General Purpose Wiring Devices.
  2. NEMA WD 2 - Semiconductor Dimmers for Incandescent Lamps.
  3. NEMA WD 6 - Wiring Device Configurations.
  4. Federal Specification WS-896-E and WC-596-F
  5. Materials and/or installation shall meet or exceed the above referenced standards.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. All devices shall conform to National Electrical Manufacturer's Association (NEMA) standards and shall be Underwriters' Laboratories, Inc., (UL) listed and labeled and shall be "Specification Grade," meeting the requirements of Federal Specification WC-596-F for receptacle, and meeting the requirements of Federal Specification WS-896-E, for switches.
- B. Switches:
1. Wall switches shall be specification grade, fully enclosed, quiet-type tumbler switches rated 20 amperes, 120/277-volt, AC rated, bakelite or composition, back and side wired, bumper pad, full rating for inductive or non-inductive loads and incandescent or fluorescent lighting loads.
  2. Single Pole Switches: Hubbell #1221, Arrow #1991, Pass & Seymour 20AC1 or equal
  3. Three-way Quiet Switches: Hubbell #1223, Arrow #1993, Pass & Seymour 20AC3 or equal.
  4. Wall switch and pilot lights shall be flush mounted combination wall type with switch and pilot light equipped with a 6-watt, 125-volt candelabra base lamp. The pilot light shall have a green jewel with brass rim flush mounted in the wall plate.
  5. All switches shall be of the same manufacturer.
  6. Normal switch color is white. Switches controlling circuits connected to emergency power source shall be red.
  7. All switches shall have terminal screws to take up to #10 AWG conductors.

C. Manual Wallbox Dimmers:

1. Wallbox dimmers shall be slider type with built-in switch and radio/T.V. interference filter. Dimmers shall be solid-state type.

D. Sensor Switch (Motion Sensor):

1. Wall sensor switch shall be infrared type, two wire connection (no neutral), 120/277V compatible with electronics ballast and working with 60 watt load. Model # 01-141 Novitas, or approved equal.
2. Ceiling sensor switch shall be infrared type. Cover 28" x 28" for corner mounting and 32" x 60" for center mounting, by Novitas, or approved equal.
3. Ceiling sensor control unit (switch pack) shall be 120/277V and installed in J-box next to lighting circuit, J-box Model #13-012 Novitas, or approved equal.

E. Receptacles:

1. Single and duplex convenience receptacles shall be U-grounded type, 125 volts, side and back wired with binding screws only with double wipe contacts and spring steel back up clips. Rating 20 amperes, 125V with straight blade grounding type. Model #5362 of Hubbell, Pass & Seymour Arrow Hart or equal.
2. Receptacles shall be red on emergency circuits, orange on isolated ground system or white for the rest.
3. Receptacles shall be green and permanently marked with the word "CONTROLLED" for controlled receptacles. Model #BR20C2GN of Hubbell or equal.
4. The grounding contact shall be one piece and internally connected to the frame with ground terminal for external ground.
5. Special receptacles shall be as indicated on plans by NEMA configuration.
6. Ground fault receptacles shall be 20 amperes, 125 volt, duplex, three wire grounding with pilot light and test and reset buttons. Suitable for feed-through wiring, color to be selected, Hubbell 5362 GF Series, Pass & Seymour 2091 SIL Series or equal.
7. Isolated ground type receptacles shall be IG 5362 Hubbell, Pass & Seymour or Arrow Hart and shall conform to UL Standard #498 and NEC/NFPA requirements, ANSI #C73.
8. Wiring devices in exposed weatherproof boxes shall be the devices specified in this section, and shall be installed in "FS" or "FD" series condulets with weatherproof cast metal covers, and gaskets as required.
9. All receptacles shall be of the same manufacturer.
10. Each receptacle installed outdoors, within 72" of sinks, in wet or damp areas, on roof, outdoors, below grade (pit), janitor, closets, and bathrooms, shall have automatic 5 ma, individual ground fault (GFI) protection.
11. Floor Outlets: Where floor outlets are shown on plans provide FSR FL-600P Series.

F. Plates:

1. Provide plates for all switches, receptacles, junction boxes, telephone and other outlets.
2. Provide engraved or etched plates for all lock switches, pilot switches, switches from which equipment or circuit controlled cannot be readily seen, three or more switches under a common plate and for switches as indicated.

3. Stainless steel plates shall be American Iron and Steel Institute (AISI) Type 302, with beveled edges, 0.040" thick with satin smooth finish. "Smoothie," Hubbell #97071 Series or equal.
4. Plastic cover plate shall be ivory / white, high impact thermoplastic, high strength, scratch-resistant, smooth and self-extinguishing, Hubbell "PI" Series, Pass & Seymour RP Series or equal.
5. Where outlets are indicated to be weatherproof, provide an AISI Type 302 stainless with double hinged covers, Pass & Seymour #WPD-8 or equal.
6. Galvanized steel plates shall be square or rectangular and hot dipped galvanized or sherardized, beveled edges and 0.040" thick. Galvanized steel plates shall be used in utility area.
7. Provide plates equipped with close fitting openings for the exact device to be used. Provide plates for telephone outlets equipped with bushed openings.
8. Refer to Section 260553 for labeling of plates.
9. Cover plates on pressed steel outlet boxes in furred areas, attics, etc., or exposed in mechanical equipment rooms shall be of the same material as the outlet box.
10. Cover plates in locations concealed from public view shall have the circuit numbers and source feed point hand labeled with marking black pen (permanent marker). See Section 260553 for labeling.
11. Provide stainless steel cover plates in the kitchen and adjacent to stainless steel panels, unless noted otherwise.
12. Verify color with Architect.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Mount switches 42" above finished floor and vertically in all locations unless indicated otherwise.
- B. All convenience and telephone outlets mounted 18" above the floor shall be installed vertically. Install receptacle with the grounding terminal up. All receptacles mounted more than 18 inches above the floor over the bench top shall be installed horizontally with the grounding terminal to the left.
- C. California Electrical Code (CEC) sized (#12 minimum) bonding jumper shall connect grounded outlet box to receptacle grounding terminal on all flush mounted units.
- D. Align and plumb all devices and plates. Plates shall fit flat against wall and tight against device surface without strain on plate.
- E. Each class of device shall be furnished by one manufacturer for total project. Mixing devices of different suppliers will not be permitted.
- F. Ganged switches on 277volt circuits shall have a barrier between each switch.
- G. Manual dimmers shall be installed in individual outlet boxes. Do not install in ganged boxes with other devices.

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**END OF SECTION 26 27 26**

## SECTION 26 28 13 - FUSES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Cartridge fuses rated 600-V ac and less for use in enclosed switches.
  - 2. Plug fuses rated 125-V ac and less for use in plug-fuse-type enclosed switches.
  - 3. Plug-fuse adapters for use in Edison-base, plug-fuse sockets.
  - 4. Spare-fuse cabinets.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
  - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
    - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
  - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
  - 3. Current-limitation curves for fuses with current-limiting characteristics.
  - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
  - 5. Coordination charts and tables and related data.
  - 6. Fuse sizes for elevator feeders and elevator disconnect switches.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Ambient temperature adjustment information.
  2. Current-limitation curves for fuses with current-limiting characteristics.
  3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
  4. Coordination charts and tables and related data.

#### 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

#### 1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Comply with UL 248-11 for plug fuses.

#### 1.7 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

#### 1.8 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Bussmann, Inc.
  2. Edison Fuse, Inc.
  3. Ferraz Shawmut, Inc.
  4. Littelfuse, Inc.

### **2.2 CARTRIDGE FUSES**

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

### **2.3 PLUG FUSES**

- A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

### **2.4 PLUG-FUSE ADAPTERS**

- A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

### **2.5 SPARE-FUSE CABINET**

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
  2. Finish: Gray, baked enamel.
  3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.
  4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 FUSE APPLICATIONS**

- A. Cartridge Fuses:
  - 1. Service Entrance: Class L, fast acting.
  - 2. Feeders: Class L, fast acting.
  - 3. Motor Branch Circuits: Class RK1, time delay.
  - 4. Other Branch Circuits: Class RK1, time delay.
  - 5. Control Circuits: Class CC, fast acting.

### **3.3 INSTALLATION**

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.
- C. Install spare-fuse cabinet(s).

### **3.4 IDENTIFICATION**

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

**END OF SECTION 26 28 13**



## SECTION 26 28 16 - 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 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."

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include 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 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.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
1. Wiring Diagrams: For power, signal, and control wiring.

## **1.6 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. 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.
- D. Manufacturer's field service report.

## **1.7 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

2. 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.

## **1.8 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.

## **1.9 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. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. 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.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NFPA 70.

## **1.10 PROJECT 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.
- B. 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 and Owner no fewer than seven days in advance of proposed interruption of electric service.

2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Architect's and Owner's written permission.
4. Comply with NFPA 70E.

## **1.11 COORDINATION**

- 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.

## **PART 2 - PRODUCTS**

### **2.1 FUSIBLE SWITCHES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- 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, capable of being grounded and bonded; 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. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.

## 2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, 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, 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, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  4. Hookstick Handle: Allows use of a hookstick to operate the handle.
  5. Lugs: Mechanical type, suitable for number, size, and conductor material.

## 2.3 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.

- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. 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.
- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. 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  $I^2t$  response.
- F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- G. 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.
- H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- J. 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 communication module with functions and features compatible with power monitoring and control system, specified in Section 260913 "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. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
12. Electrical Operator: Provide remote control for on, off, and reset operations.

## **2.4 ENCLOSURES**

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
  1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  2. Outdoor Locations: NEMA 250, Type 3R.
  3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
  4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

## **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.

### **3.2 INSTALLATION**

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.4 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 inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. 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.
- D. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- E. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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 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.
  - 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.



- F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. 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 260573 "Overcurrent Protective Device Coordination Study."

**END OF SECTION 26 28 16**

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## **SECTION 26 33 23 - CENTRAL BATTERY EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Furnishing, installing and connecting emergency system to lighting fixtures, signal systems, and electrical loads as indicated on Drawings.

#### **1.2 DEFINITIONS**

- A. CIS: Central Inverter System.
- B. UPS: Uninterruptible Power Supply.

#### **1.3 DESIGN REQUIREMENTS**

- A. Emergency systems shall be supplied from storage batteries with charging unit with a minimum of 90 minutes back-up capacity for lighting systems by the furnishing of an CIS, and a minimum of 90 minute back-up for PABX-PA Systems by furnishing of an UPS. These 2 systems shall be separate and independent of each other. Systems shall be installed in accordance with requirements of all codes and regulations.

#### **1.4 QUALITY ASSURANCE**

- A. The manufacturer shall have been producing inverter system equipment for at least 5 consecutive years.
- B. Systems shall undergo full load burn in testing at the factory.
- C. Systems shall be listed by UL, or another Nationally Recognized Testing Laboratory (NRTL).
- D. A manufacturer's technical representative shall be available for system start-up, warranty work, and service calls.

#### **1.5 WARRANTY**

- A. Manufacturer shall provide a 2 year material warranty and a 20 year material warranty for battery cells.
- B. Installer shall provide a 2 year labor warranty.

## PART 2 - PRODUCTS

### 2.1 COMPONENTS

#### A. CIS and UPS:

1. General: Each system shall be furnished with following features:
  - a. System shall automatically protect itself against damage from overloads and short circuits while powered from either utility AC or during emergency inverter operations. System shall automatically disconnect load when battery voltage drops below approximately 85 percent of nominal battery voltage.
  - b. Batteries of system shall be maintenance-free type with lead calcium grids and shall be provided with a 20-year manufacturer's warranty. Batteries shall have sufficient capacity to power inverter at full rated load for a minimum of 90 minutes for lighting loads and PABX and PA systems, without battery voltage dropping below 85 percent of nominal battery voltage. Battery manufacturer's data sheets shall be provided indicating recommended charge rates, operating conditions and warranty years. Batteries shall be connected and installed in accordance with recommendations of battery manufacturer, and shall be individually labeled with make and model identification. Secure batteries to withstand seismic vibrations. Batteries shall be replaceable in field.
  - c. System shall be enclosed in a heavy gage, commercial grade steel cabinet, including hinged and lockable doors. Locks shall be keyed to Corbin No. 60 keys. Provide input and output manual disconnects for UPS System. Provide complete operating service and parts manuals including, but not limited to, electrical diagrams and factory test data.
2. CIS shall be furnished with following additional features:
  - a. A microprocessor shall oversee inverter, and provide programmable functional self-test according to NFPA 101 to ensure optimal system and sub-system performance. If abnormal conditions or failure occur, warning messages shall be issued and alarms shall be sounded so that timely action maybe taken to alleviate problem or repair system. If inverter becomes inoperable, microprocessor shall be capable of shutting down components to prevent further damage.
  - b. The unit shall include a self-diagnostic facsimile modem that sends a detailed unit status report when:
    - 1) A self-test is performed.
    - 2) An alarm condition exists.
    - 3) The status report shall be sent to 6 user defined locations. These locations can be preprogrammed at factory, programmed on site by customer, or remotely programmed by factory once system is installed.
    - 4) The self/diagnostic facsimile shall allow for remote monitoring and troubleshooting of any abnormal conditions. The facsimile shall be provided with a dedicated telephone line off of PBX system.

- c. System shall be self contained, UL924 listed, designed to provide no-break power to operate specified lighting load for 90 minutes upon power loss or brown out of utility voltage.
  - d. The system's operation is to be fully automatic. It shall use a linear transformer, with boost tap and surge protection devices. Inverter shall be of Pulse Width Modulated (PWM) design, and shall provide true "no-break" power to load at all times. During normal operation, charger maintains battery bank at full capacity. The three on-board microprocessors continuously monitor charger settings and system's overall readiness. System consists of circuitry including an automatic, multi-rate, software controlled charger; continuous self-diagnostics monitoring 265 various parameters, and programmable system testing capabilities. System shall incorporate 30 individual alarms and 9 systems logs. All Logs and Alarms are to be automatically recorded and readily displayed through microprocessor controlled User Interface Display (UID). System shall also include a RS232 Serial port for remote communications.
  - e. The system's automatic overload and short circuit protection in normal and emergency operations shall consist of 150% momentary surge capability, 120% overload for 5 minutes, and 110% overload for 10 minutes. System protection shall also include a low battery voltage disconnect, AC input circuit breaker, a DC input fuse and switch, and an AC output fuse. System shall supply a digitally generated sinusoidal output waveform (PWM) with less than 5% total harmonic distortion at rated linear load. A boost tap transfer protection circuit shall maintain desired output voltage during low voltage "brownout" situations, without continuously switching to batteries; thereby preserving battery capacity.
  - f. Start Up and Maintenance: Microprocessor shall contain commission data including unit size, serial number, order number, and battery configuration. Software shall be furnished to assist in installation of equipment, brownout selection, and functional self-test.
  - g. Unit shall be furnished with 5 normally on output circuit breakers with alarm, and 5 normally off circuit breakers with alarm. Provide a descriptive circuit designation schedule.
  - h. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) LSN by Dual-Lite
    - 2) Illuminator by Myers Power Products
    - 3) Or District approved equal.
3. UPS shall have following additional features:
- a. System shall be a self-contained, hard-wired (input and output), UL listed system designed to provide continuous AC power; it shall be fully compatible with connected loads and shall provide a sinusoidal output waveform with 6 percent or less of maximum total harmonic distortion. System input and output ratings shall be as indicated on Drawings. System shall have a throughput efficiency (with utility power on) of at least 90 percent, excluding charger and shall include, but not be limited to, AC sensing equipment, automatic transfer switch, battery charger, batteries, DC to AC inverter, ferro-resonant transformer, and rectifier.
  - b. Sensing and transfer equipment shall operate as follows:

- 1) Under normal operating conditions, load shall be powered by normal AC line supply that has been filtered through ferro-resonant transformer. When AC line power is present, inverter shall be off; battery charger shall be off if batteries are fully charged.
  - 2) When AC line power fails, inverter shall supply AC power to transformer from batteries. There shall be no interruption or reduction in output of system during transfer from normal AC line supply to inverter battery supply, or back to line.
- c. Battery charger shall be furnished with solid-state circuitry and shall provide a high charge rate, capable of restoring batteries to full rated capacity within 12 hours. High charge and float charge characteristics shall comply with Specifications and recommendations of battery manufacturer. Battery charger shall operate properly throughout an input voltage range of 5 percent above and below nominal line voltage. Battery charger shall operate at 85 percent minimum efficiency.
- d. Battery shall be sealed, maintenance free, gas recombinant, self venting, with a suspended electrolyte. Batteries must be factory tested and approved for use with specific inverter.
- e. Solid-state DC to AC inverter shall be capable of driving full rated load at a power factor of 0.85 leading to 0.85 lagging, and shall maintain a frequency between 59 and 61 cycles per second at rated output voltage, throughout all operating conditions. U.P.S. shall be furnished with at least 4 - 20 amp outlets and a power cord of at least 5 foot in length.
- f. Ferro-resonant transformer shall provide filtered AC power to load and protect it against following abnormal conditions such as spikes, sags, surges, noise, lightning, and brownouts.
- g. System shall be provided with a standard RS232 port to allow interface with computer or remote monitoring station. Additionally, system shall be furnished with a front panel keyboard and LCD display furnished with following metering and control capabilities:
- 1) Meter functions: AC volts out, AC volts in, battery voltage, AC current in, AC current out, VA load, DC current, frequency, heat sink temperature, ambient temperature, time, number of power outages, log of power outages, projected run time available, system hours, inverter hours, number of overloads.
  - 2) Alarm messages for: high AC out, low AC out, near low battery, low battery voltage, high battery voltage, ambient over temperature, heat sink over temperature, inverter on, overload, DC disconnect, charger on to long, charger off too long.
  - 3) Set points for: high AC voltage, low AC voltage, high battery voltage, low battery voltage, near low battery, high heat sink temperature, high ambient temperature, frequency tolerance, baud rate (2400 or 4800 BPS), battery capacity, battery charge voltage, charger equalize hours, equalize cycle.\
- h. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1) Eaton Corporation

- 2) Powerware Ferrups Series
- 3) Or equal.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION, SYSTEM SHIPPING, START-UP AND TESTING**

- A. Shipping: System shall be shipped separately from batteries. Batteries shall be shipped to Project site directly from battery supplier and shall remain in their sealed cartons until opened and examined in presence of IOR. Batteries shall be shipped to Project site not more than 30 days before system start-up.
- B. Start-Up: System start-up shall be performed by a technical representative of manufacturer, in presence of Architect, with loads connected, and shall include necessary testing and adjusting to assure proper operation of system functions. System start-up shall include follow-up visits as required. Following start-up, maintain system on a normally OFF input circuit until Substantial Completion.
- C. Testing: Before Substantial Completion, conduct in presence of Architect, a complete performance testing of system. Testing shall include operating system in emergency mode for at least 90 minutes for CIS, and for at least 90 minutes for UPS, with loads connected, while monitoring battery voltage, output voltage and output frequency. Power factor of load shall be measured to ascertain compatibility with system. Furnish and operate necessary test equipment.
- D. Equipment shall be anchored in accordance with California Zone 4 seismic requirements

#### **3.2 BATTERIES**

- A. Batteries shall be complete with necessary connectors and accessories, fully charged, and ready for service.
- B. Documentation for 20 year manufacturer's warranty for all batteries shall be delivered to Architect.

#### **3.3 SERVICE MANUALS**

- A. Service Manuals: Submit service manuals to OAR including following:
  1. A detailed explanation of operation of system
  2. Instructions for routine maintenance.
  3. Detailed instructions for repair of major components of system.
  4. Pictorial parts list and parts numbers.
  5. Pictorial and schematic electrical drawings of wiring systems, including operating and safety devices, and major components.
  6. Programming Instructions.
  7. Program listing.

8. Final test report.
9. Installation Instructions: Submit manufacturer's written installation instructions.

### **3.4 TRAINING**

- A. Before Substantial Completion, provide the services of a manufacturer's representative on the Project site to instruct persons designated by the Owner in the operation and maintenance of the system. Instruction time shall not be less than 4 hours. Provide training video and training materials to designated owner's personnel.

**END OF SECTION 26 33 23**



## SECTION 26 51 00 - INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, and drivers.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

B. Related Sections:

1. Section 260943 "Network Lighting Controls" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

#### 1.2 REFERENCES

- A. ANSI/NFPA 70, National Electrical Code
- B. IESNA LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products
- C. IESNA LM-80, Approved Method for Measuring Lumen Maintenance of LED Light Sources
- D. IESNA TM-21, Luminaire Classification System for Indoor Luminaires
- E. UL1598, Standard for Safety of Luminaires

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, and finishes.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

## **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. Comply with NFPA 70.
- C. Luminaires shall be fully assembled and individually electrically tested prior to shipment.
- D. Manufacturers of LED luminaires shall demonstrate a suitable testing program to ensure system reliability and to substantiate lifetime claims.
- E. The sole use of IESNA LM-80 data to predict luminaire lifetime is not acceptable.
- F. At time of manufacture, electrical and light technical properties shall be recorded for each luminaire. At a minimum, this should include lumen output, CCT, and CRI. Each luminaire shall utilize a unique serial numbering scheme. Technical properties must be made available for a minimum of 5 years after the date of manufacture.
- G. Luminaires shall be provided with a minimum 5 year warranty covering, LEDs, drivers and paint finish.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

### **2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS**

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
- C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.
- E. Metal Parts: Free of burrs and sharp corners and edges.
- F. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

- G. 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.
- H. Diffusers and Globes:
  - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least [0.125 inch (3.175 mm)] minimum unless otherwise indicated.
    - b. UV stabilized.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.

### **2.3 DRIVERS FOR LED FIXTURES**

- A. Electronic Driver for LED Fixtures: Comply with UL 1310 Class 2 requirements for dry and damp locations. Include the following features unless otherwise indicated:
  - 1. Rated for 50,000 hours of life, unless otherwise noted.
  - 2. Sound Rating: Class A.
  - 3. Total Harmonic Distortion Rating: 15 percent or less.
  - 4. Current Crest Factor: 1.5 or less.
  - 5. 0-10V Dimming Standard (Step Dimming does not qualify)

### **2.4 EXIT SIGNS**

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
  - 1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
  - 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
    - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

## 2.5 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
1. Battery: Sealed, maintenance-free, lead-acid type.
  2. Charger: Fully automatic, solid-state type with sealed transfer relay.
  3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
  7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.

## 2.6 LED FIXTURES

- A. Except as otherwise indicated, provide LED luminaires, of types and sizes indicated on fixture schedules.
- B. Include the following features unless otherwise indicated:
1. Each Luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply).
  2. Each luminaire shall be rated for a minimum operational life of 50,000 hours utilizing a minimum ambient temperature of (25°C).
  3. Light Emitting Diodes tested under LM-80 Standards for a minimum of 12,000 hours.
  4. Color Rendering Index (CRI) of 82 at a minimum.
  5. Color temperature 4000K, unless otherwise indicated.
  6. Rated lumen maintenance at 70% lumen output for 50,000 hours, unless otherwise indicated.
  7. Fixture efficacy of 60 Lumens/Watt, minimum.
  8. 5 year luminaire warranty, minimum.
  9. Photometry must comply with IESNA LM-79.
  10. The individual LEDs shall be constructed such that a catastrophic loss of the failure of one LED will not result in the loss of the entire luminaire.
  11. Luminaire shall be constructed such that LED modules may be replaced or repaired without the replacement of the whole fixture.
- C. Technical Requirements

1. Luminaire shall have a minimum efficacy of 60 lumens per watt. The luminaire shall not consume power in the off state.
2. Operation Voltage: The luminaire shall operate from a 50 HZ to 60 HZ AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.
3. Power Factor: The luminaire shall have a power factor of 0.9 or greater.
4. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 15 percent.
5. Operational Performance: The LED circuitry shall prevent visible flicker to the unaided eye over the voltage range specified above.

**D. Thermal Management**

1. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
2. The LED manufacturer's maximum thermal pad temperature for the expected life shall not be exceeded.
3. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.
4. The luminaire shall have a minimum heat sink surface such that LED manufacturer's maximum junction temperature is not exceeded at maximum rated ambient temperature.

**2.7 LIGHTING FIXTURE SUPPORT COMPONENTS**

- A. Comply with Section 260529 "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 (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Comply with NFPA 70 for minimum fixture supports.

- C. Suspended Lighting Fixture Support:
  - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
  - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### **3.2 FIELD QUALITY CONTROL**

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. 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.

**END OF SECTION 26 51 00**

## SECTION 26 56 00 - 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 luminaires with lamps and drivers.
  - 2. Luminaire-mounted photoelectric relays.
  - 3. Poles and accessories.
- B. Related Sections:
  - 1. Section 265100 "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.
  - 2. Section 260519 "Low Voltage Electrical Power Conductors and Cables".

#### 1.3 DEFINITIONS

- A. AASHTO: American Association of State Highway and Transportation Officials
- B. CCT: Correlated color temperature.
- C. CRI: Color-rendering index.
- D. HID: High-intensity discharge.
- E. IESNA: Illuminating Engineering Society of North America
- F. LER: Luminaire efficacy rating.
- G. Luminaire: Complete lighting fixture, including ballast housing if provided.
- H. Pole: Luminaire support structure, including tower used for large area illumination.
- I. Standard: Same definition as "Pole" above.

#### **1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION**

- A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4-M.
- B. Live Load: Single load of 500 lbf, distributed as stated in AASHTO LTS-4-M.
- C. Ice Load: Load of 3 lbf/sq. ft., applied as stated in AASHTO LTS-4-M Ice Load Map.
- D. Wind Load: Pressure of wind on pole and luminaire and banners and banner arms, calculated and applied as stated in AASHTO LTS-4-M.
  - 1. Basic wind speed for calculating wind load for poles 50 feet high or less is 100 mph
    - a. Wind Importance Factor: 1.0
    - b. Minimum Design Life: 25 years
    - c. Velocity Conversion Factors: 1.0.

#### **1.5 ACTION SUBMITTALS**

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation indicated on Contract Documents. Include data on features, accessories, finishes, and the following:
  - 1. Manufacturer's dimensioned scale drawings showing in complete detail the fabrication of all lighting fixtures including overall dimensions, finishes, metal thickness, glass thickness, type, fabrication methods, support method, ballasts, transformers, sockets, type of shielding, reflectors, trims, hinges, gaskets, provisions for relamping and all other information to show compliance with contract documents.
  - 2. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
  - 3. Details of attaching luminaires and accessories.
  - 4. Details of installation and construction.
  - 5. Luminaire materials.
  - 6. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories. Photometric data shall be developed according to methods of IESNA.
    - a. Testing Agency Certified Data: For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
    - b. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
  - 7. Ballasts, including energy-efficiency data.
  - 8. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.
  - 9. Materials, dimensions, and finishes of poles.



10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
  11. Anchor bolts for poles.
  12. Manufactured pole foundations.
- 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. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
  3. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.
  4. Wiring Diagrams: For power, signal, and control wiring.
  5. For outdoor pathway, parking and roadway luminaires submit photometric calculations with point by point summary layout plan. isocandela charts, coefficients of utilization and IES roadway distribution classification.
  6. Maintenance and operating instructions including tools required, types of cleaners to be used, replacement parts and final as-built shop drawings and name of the project, Architect and Lighting Consultant.
- C. Fixtures under the contract shall be identical with the approved sample fixture. No fixture used as a sample shall be allowed to be installed on the project.
- D. In the event the submission are disapproved, the fixtures shall be returned to the contractor to immediately make a new submission of the fixture in compliance with the contract documents at no additional cost to the owner.
- E. All charges for these shipments shall be prepaid by the contractor.

## **1.6 INFORMATIONAL SUBMITTALS**

- A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a professional engineer.
- B. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.
- C. Field quality-control reports.
- D. Warranty: Sample of special warranty.

## **1.7 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.

## **1.8 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. Glass and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least two (2) of each type.
  - 2. Drivers: One for every 100 of each type and rating installed. Furnish at least two (2) of each type.

## **1.9 QUALITY ASSURANCE**

- A. Materials and appurtenances as well as workmanship provided under this section shall conform to highest commercial standards, and as specified and as indicated on drawings. Fixture parts and components not specifically identified or indicates shall be made of materials most appropriate to their use or function and as such resistant to corrosion and thermal and mechanical stresses encountered in the normal application and function of the fixtures.
- B. All fixtures shall be manufactured to a consistent level of quality. Size, color and component shall be identical for all fixtures of same types.
- C. All fixtures and components shall be made in accordance with applicable codes and standards such as NEC, CEC and bear the label of independent laboratories such as Underwriters Laboratories (UL) or Factory Mutual (FM).
- D. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- E. 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.
- F. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Comply with IEEE C2, "National Electrical Safety Code."
- H. Comply with NFPA 70.

### **1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation. Handle poles with web fabric straps.
- D. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

### **1.11 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
  - 1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
  - 2. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings and/or specifications.

### **2.2 GENERAL REQUIREMENTS FOR LUMINAIRES**

- A. Luminaires shall comply with UL 1598 and be UL listed and labeled for installation in wet locations.
- B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. 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. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- J. 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.
- K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- L. 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.
- M. 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, "Solvent Cleaning," 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, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
  - 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 custom color.
    - c. Color: As selected by Architect from manufacturer's full range.
- N. 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; 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: Custom color.
- O. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. 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 and ballast characteristics:
    - a. "USES ONLY" and include specific lamp type.
    - b. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
    - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
    - d. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
    - e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
    - f. CCT and CRI for all luminaires.

### **2.3 DRIVERS FOR LED FIXTURES**

- A. Electronic Driver for LED Fixtures: Comply with UL 1310 Class 2 requirements for dry and damp locations. Include the following features unless otherwise indicated:
1. Rated for 50,000 hours of life, unless otherwise noted.
  2. Sound Rating: Class A.
  3. Total Harmonic Distortion Rating: 15 percent or less.
  4. Current Crest Factor: 1.5 or less.
  5. 0-10V Dimming Standard (Step Dimming does not qualify)

### **2.4 LED FIXTURES**

- A. Except as otherwise indicated, provide LED luminaires, of types and sizes indicated on fixture schedules.
- B. Include the following features unless otherwise indicated:

1. Each Luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply).
2. Each luminaire shall be rated for a minimum operational life of 50,000 hours utilizing a minimum ambient temperature of (25°C).
3. Light Emitting Diodes tested under LM-80 Standards for a minimum of 12,000 hours.
4. Color Rendering Index (CRI) of 82 at a minimum.
5. Color temperature 4000K, unless otherwise indicated.
6. Rated lumen maintenance at 70% lumen output for 50,000 hours, unless otherwise indicated.
7. Fixture efficacy of 60 Lumens/Watt, minimum.
8. 5 year luminaire warranty, minimum.
9. Photometry must comply with IESNA LM-79.
10. The individual LEDs shall be constructed such that a catastrophic loss of the failure of one LED will not result in the loss of the entire luminaire.
11. Luminaire shall be constructed such that LED modules may be replaced or repaired without the replacement of the whole fixture.

C. Technical Requirements

1. Luminaire shall have a minimum efficacy of 60 lumens per watt. The luminaire shall not consume power in the off state.
2. Operation Voltage: The luminaire shall operate from a 50 HZ to 60 HZ AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.
3. Power Factor: The luminaire shall have a power factor of 0.9 or greater.
4. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 15 percent.
5. Operational Performance: The LED circuitry shall prevent visible flicker to the unaided eye over the voltage range specified above.

D. Thermal Management

1. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
2. The LED manufacturer's maximum thermal pad temperature for the expected life shall not be exceeded.
3. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.
4. The luminaire shall have a minimum heat sink surface such that LED manufacturer's maximum junction temperature is not exceeded at maximum rated ambient temperature.

## **2.5 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS**

A. Structural Characteristics: Comply with AASHTO LTS-4-M.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.

2. **Strength Analysis:** For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. **Luminaire Attachment Provisions:** Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.
- C. **Mountings, Fasteners, and Appurtenances:** Corrosion-resistant items compatible with support components.
  1. **Materials:** Shall not cause galvanic action at contact points.
  2. **Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers:** Hot-dip galvanized after fabrication unless otherwise indicated.
  3. **Anchor-Bolt Template:** Plywood or steel.
- D. **Handhole:** Oval-shaped, with minimum clear opening of 2-1/2 by 5 inches, with gasketed cover secured by stainless-steel captive screws.
- E. **Concrete Pole Foundations:** Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- F. **Power-Installed Screw Foundations:** Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.
- G. **Breakaway Supports:** Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4-M.

## **2.6 STEEL POLES**

- A. **Poles:** Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.
  1. **Shape:** Square, straight.
  2. **Mounting Provisions:** Butt flange for bolted mounting on foundation or breakaway support.
- B. **Steel Mast Arms:** Single-arm type, continuously welded to pole attachment plate. Material and finish same as pole.
- C. **Brackets for Luminaires:** Detachable, cantilever, without underbrace.
  1. **Adapter fitting welded to pole,** allowing the bracket to be bolted to the pole mounted adapter, then bolted together with galvanized-steel bolts.

2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.
  3. Match pole material and finish.
- D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- E. Steps: Fixed steel, with nonslip treads, positioned for 15-inch vertical spacing, alternating on opposite sides of pole; first step at elevation 10 feet above finished grade.
- F. Intermediate Handhole and Cable Support: Weathertight, 3-by-5-inch handhole located at midpoint of pole with cover for access to internal welded attachment lug for electric cable support grip.
- G. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- H. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.
- I. Platform for Lamp and Ballast Servicing: Factory fabricated of steel with finish matching that of pole.
- J. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- K. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.
- L. Factory-Painted Finish: 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, "Solvent Cleaning," 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, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."
  2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
  3. 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 by Architect from manufacturer's full range.



## PART 3 - EXECUTION

### 3.1 POLE INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on Drawings:
  - 1. Fire Hydrants and Storm Drainage Piping: 60 inches.
  - 2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet
  - 3. Trees: Per landscape architect direction.
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
  - 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
  - 2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
  - 3. Install base covers unless otherwise indicated.
  - 4. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- E. Embedded Poles with Tamped Earth Backfill: Set poles to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.
  - 1. Dig holes large enough to permit use of tampers in the full depth of hole.
  - 2. Backfill in 6-inch layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.
- F. Embedded Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.
  - 1. Footing diameter as indicated on drawings.
  - 2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of 3000 psi at 28 days, and finish in a dome above finished grade.
  - 3. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through concrete dome. Arrange to drain condensation from interior of pole.
  - 4. Cure concrete a minimum of 72 hours before performing work on pole.
- G. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch- wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch below top of concrete slab.

- H. Raise and set poles using web fabric slings (not chain or cable).

### **3.2 BOLLARD LUMINAIRE INSTALLATION**

- A. Align units for optimum directional alignment of light distribution.
- B. Install on concrete base with top 4 inches above finished grade or surface at bollard 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 033000 "Cast-in-Place Concrete."

### **3.3 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES**

- A. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

### **3.4 CORROSION PREVENTION**

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

### **3.5 GROUNDING**

- A. Ground metal poles and support structures according to Section 260526 "Grounding and Bonding for Electrical Systems."
  - 1. Install grounding electrode for each pole unless otherwise indicated.
  - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- B. Ground nonmetallic poles and support structures according to Section 260526 "Grounding and Bonding for Electrical Systems."
  - 1. Install grounding electrode for each pole.
  - 2. Install grounding conductor and conductor protector.
  - 3. Ground metallic components of pole accessories and foundations.

### **3.6 FIELD QUALITY CONTROL**

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
  - 1. Verify operation of photoelectric controls.
- C. Illumination Tests:
  - 1. Measure light intensities at night. Tests shall be witnessed by Architect and/or Owner's representative. Provide two (2) weeks advance notice. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):
    - a. IESNA LM-72, "Directional Positioning of Photometric Data."
- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

### **3.7 CLEANUP**

- A. Remove rubbish, debris, and waste materials from all areas of work each day.
- B. Clean fixture surfaces of dirt, cement, plaster, and debris. Furnish cleansers compatible with material surfaces being cleaned.

**END OF SECTION 26 56 00**

**P2S Inc.**  
005.2882.000

January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

## **SECTION 27 00 00 - GENERAL COMMUNICATIONS REQUIREMENTS**

### **PART 1 - GENERAL**

#### **1.1. SUMMARY**

- A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end structured cabling system. This includes - but is not limited to - furnishing and installing cable, cable supports, patch cords, cable ties, innerduct, racks, cabinets, termination components, ancillary equipment, testing, and labeling and documentation of cables and connectors, for a complete end-to-end solution.
- B. The work covered under this Section shall include the installation of all wireless access points and associated mounting hardware provided by the Owner as defined in Section 271500, Part 2.16. Contactor shall coordinate receipt of WAP devices and installation schedule with the Owner.
- C. Refer to the contract documents for locations of Telecom Rooms (TRs) and telecommunication outlets (TOs). Note that the port and cable count at each TO may vary by location.
- D. Complete installation shall comply with the Owner provided latest telecommunications and IT standards documents.
- E. It shall be the responsibility of the contractor, to work with the Owner and provide the necessary assistance to make any connections from the owners' outside plant, service provider to establish services which shall ride on the new cabling system. These activities include, but are not limited to patch cords, cross connects, general wiring, documentation, and cable pair identification.

#### **1.2. RELATED DOCUMENTS**

- A. General and Supplementary Conditions
- B. Long Beach City College District Standards. Liberal Arts Campus / Pacific Coast Campus.

#### **1.3. RELATED SECTIONS**

- A. Division 01 – General Conditions
- B. Division 07 – Penetration Firestopping
- C. Division 26 - Grounding and Bonding
- D. Division 26 - Raceway and Boxes

- E. Division 26 - Wiring Devices
- F. Division 27 - Communications

#### 1.4. ACRONYMS AND DEFINITIONS

- A. BICSI: Building Industry Consulting Service International
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection
- C. EMI: Electromagnetic interference
- D. Horizontal Cabling: Cabling between and including the telecommunications outlet/connector and the horizontal cross-connect
- E. IDC: Insulation displacement connector
- F. LAN: Local area network
- G. NRTL: Nationally Recognized Testing Laboratory, an independent agency, with the experience and capability to conduct the testing indicated, as defined by OSHA in 29 CFR 1910.7
- H. RCDD: Registered Communications Distribution Designer, a BICSI-certification
- I. RMC: Rigid metallic conduit
- J. TR: Telecom Room
- K. UTP: Unshielded twisted pair
- L. Category 6A UTP, as defined by TIA standards

#### 1.5. CONTRACTOR QUALIFICATIONS

- A. The contractor shall be a company specializing in the installation of communication cable and accessories with a minimum of five years documented experience on similar systems.
- B. Must be a current certified partner of the solutions being furnished and installed in order to meet the requirements for the extended warranty and service programs.
- C. Must hold a current communications cabling license within the State the project is taking place and must be verifiable for good standing.
- D. Contractor must have a current affiliation with BICSI.
- E. Within the project's onsite team, 15 percent of installers shall hold a BICSI Installer 1 certification, 15 percent of installers shall also hold a BICSI Installer 2 certification (Both

Optical Fiber and Copper). Ten percent of the team shall hold a BICSI ITS Technician certification and a minimum of (1) team member shall hold a current and valid BICSI RCDD certification.

- F. All BICSI certified field installers shall take on roles of Foreman or Team Lead to ensure installations are deemed compliant per codes and standards.
- G. Contractor must have satisfactorily completed (3) projects within the past 5 years of similar scope and size within the same state.
- H. The selected Contractor shall provide a Project Manager to act a single point of contact for all activities performed under this section. The Project Manager shall be a Registered Communications Distribution Designer (RCDD). The RCDD shall have a minimum of 3 years of experience in design and installation. The designer must have sufficient experience in this type of project as to be able to lend adequate technical support to the field forces during installation, during the warranty period and during any extended warranty periods or maintenance contracts. The Contractor must attach a resume of the responsible designer to the Contractor's submittal for evaluation.
- I. The Project Manager, or designee thereof, shall be required to attend project meetings as required until project closeout/signoff.
- J. Should the Project Manager assigned to this project change during the installation, the new Project Manager assigned must meet all qualifications stated in this section, and must also submit a resume for review by the Consultant.
- K. If, in the opinion of the Consultant, the Project Manager does not possess adequate qualifications to support the project, the Consultant reserves the right to require the Contractor to assign a designer whom, in the Owner's opinion, possesses the necessary skills and experience required of this project.

## 1.6. REGULATORY REFERENCES

- A. ANSI/NFPA 70
- B. City of Long Beach Building Code.
- C. Division of the State Architect Compliance Publications.
- D. ANSI/IEEE C2 - National Electrical Safety Code (NESC)
- E. NFPA 70-2011 - National Electrical Code (NEC)
- F. ANSI/TIA-568.0-D – Generic Telecommunications Cabling for Customer Premises
- G. ANSI/TIA-568.1-D – Commercial Building Telecommunications Cabling Standard
- H. ANSI/TIA-568.2-D – Balanced Twisted Pair Telecommunication Cabling and Components Standard

- I. ANSI/TIA-568.3-D – Optical Fiber Cabling and Components Standard
- J. ANSI/TIA-569-D – Telecommunications Pathways and Spaces
- K. ANSI/TIA-569-D-1 – Telecommunications Pathways and Spaces: Addendum 1- Revised Temperature and Humidity Requirements for Telecommunications Spaces
- L. ANSI/TIA-606-C – Administration Standard for Telecommunications Infrastructure
- M. ANSI/TIA-607-D – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- N. ANSI/TIA-758-B – Customer Owned Outside Plant Telecommunications Infrastructure Standard
- O. IEEE 142 “Green Book”- Recommended Practice for Grounding of Industrial and Commercial Power Systems.
- P. UL 444 - Standard for Communications Cable.
- Q. Rural Electrification Administration (REA) PE-89 - specification for filled telephone cables with expanded insulation.
- R. Rural Electrification Administration (REA) PE-39 - specification for filled telephone cables
- S. NEC Article 250 and Article 800.
- T. CEC Article 18-27-300.22©(1)
- U. NEC Article 250 for System Grounding.
- V. NEC Articles 770 and 800 for Cable Listing Requirements.
- W. Work performed should additionally comply with and follow guidelines established in the latest edition/revision, as of the date of the Contract Documents, of the following publications:
  - 1. BICSI Telecommunications Distribution Methods Manual (TDMM)
  - 2. BICSI Outside Plant Design Reference Manual (OSPDRM)
  - 3. National Electrical Contractors Association (NECA)/BICSI ANSI/NECA/BICSI-568-2006 Standard for Installing Commercial Building Telecommunications Cabling
- X. All materials shall be new and listed by UL and shall bear the UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.
- Y. Notify Consultant of all material believed to be inadequate, unsuitable, in violation of law, ordinances, rules or regulations of authorities having jurisdiction.



## 1.7. CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Consultant for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Consultant for a decision before proceeding.

## 1.8. SUBMITTALS

- A. Submittals shall include complete documentation of the system, products and accessories in a single submittal. Incomplete submittals will be returned unreviewed.
- B. Prior to the start of work the Contractor shall submit shop drawings in an electronic form. Plans shall be fresh designs by the contractor; they cannot be overlays of the Consultant's package which are indicative as the contract documents. Shop drawings shall contain:
  - 1. Full size floor plans showing proposed cable routing, wire basket routes, labeling of all outlets, locations of pull boxes.
  - 2. Full size floor plans and elevations of all telecommunication room racks and cabinets; also include all walls with equipment.
  - 3. Elevations shall indicate part numbers and quantities for all equipment.
  - 4. Elevations of all types of outlet faceplates which shall include the configuration for jacks, blanks and the intended outlet labeling schemes.
  - 5. Floor plans shall include all ladder rack or overhead cable distribution hardware within the telecommunications rooms to be installed per manufacturer's instructions.
  - 6. Outside plant manhole and handhole designs coordinated with electrical as well as the site environment.
  - 7. Outside plant conduit arrangement details within duct bank and within the manholes and handholes as necessary.
  - 8. Outside plant conduit duct bank overall routing coordinated with electrical as well as the site environment.
  - 9. All seismic bracing and support details shall be provided in coordination with the general contractor as needed.
- C. Submittals shall include faceplates mockups sent to the Consultant for final review. Mockups shall have the manufacturer's cable markings clearly visible. The following are standard items that are to be submitted.
  - 1. Wall mounted outlet complete with faceplate, terminated jacks, blanks, and labeling for all types of outlets in project. Outlet should also contain 24" minimum of the cable proposed for the project.
  - 2. Wireless outlet complete with jacks, blanks, and labeling.
  - 3. Wall phone (stainless steel) outlet.

4. Modular furniture outlet complete with faceplate, jacks, blanks and labeling.
  5. Raceway outlet complete with faceplate, bezel, jacks, blanks and labeling.
  6. Floor box outlet complete with faceplate, mounting plate, jacks and labeling.
- D. Where applicable, dimensions should be marked in units to match those specified.
- E. Work shall not proceed without the consultant's "no exception taken" of the submitted items.
- F. Floor plans will be provided to the Contractor in electronic (AutoCAD, ".dwg") formats to be utilized by the Contractor in creating complete submittals and as-built documentation. These modified documents shall be provided to the Owner as part of the Record Documents.
- G. Plans shall be fresh designs by the contractor, they cannot be overlays of the consultant's package which is indicative as contract documents.
- H. All submittal documentation shall bear the stamp of a currently verifiable BICSI RCDD.
- I. Contractor must submit documentation to support all Contractor Qualifications and Requirements under Section 1.5 which is to include but not limited to the following:
1. End to end solution and partner documentation indicating contractor's staff has gone through proper channels and training support a minimum 25 year warranty and service program by the manufacturers.
  2. BICSI affiliations by contractor.
  3. BICSI cabling team's RCDD, Installer 1, Installer 2 (Optical Fiber and Copper) and ITS Technician certifications.
  4. Current copy of the State contractor's license for Communications Cabling.
  5. Documentation of (3) similar projects within the past 5 years in the same State.
- J. Contractor shall include data sheets and literature of test equipment to be used for fiber and copper cabling and components.

#### **1.9. MANUFACTURER CERTIFIED WARRANTY**

- A. The manufacturer shall be a company specializing in communication cable and/or accessories with a minimum of five years documented experience in producing cable and/or accessories similar to those specified below.
- B. The system shall be comprised of components from a single manufacturer or a combination of manufacturers entering into a partnering agreement that allows for a warranty of the system.
- C. System warranty program documents must be from that of the cabling and component manufacturer and associated partners. Cabling and component warranty programs offered by the contractor alone are not acceptable.
- D. The warranty period shall be for not less than 25 years and warranty the cabling system and components will perform to the stated specifications for the warranty period.

### 1.10. QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- B. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
- C. Requirement for specialists shall not supersede building codes and regulations governing the Work.
- D. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and performance.

### 1.11. QUALITY CONTROL

- A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
- B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.
- C. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work.
- D. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

### 1.12. OWNER STANDARDS

- A. Work performed should additionally comply with Owner Standards.

## PART 2 - PRODUCTS (NOT APPLICABLE)

## **PART 3 - EXECUTION**

### **3.1. GENERAL**

- A. Contractor shall follow standard industry installation practices as described in the latest release of the BICSI TDMM.
- B. Contractor shall be responsible for identifying and reporting to the Site Coordinator(s) any existing damage to walls, flooring, tiles and furnishings in the work area prior to start of work. All damage to interior spaces caused by the installation of cable, pathways or other hardware must be repaired by the Contractor. Repairs must match preexisting color and finish of walls, floors and ceilings. Any contractor-damaged ceiling tiles are to be replaced to match color, size, style and texture.
- C. The installation shall be supervised on site by a BICSI certified installer.
- D. The contractor shall have on staff a BICSI certified RCDD. RCDD certification shall be current and each submittal shall bear the stamp of the RCDD.
- E. Outlets shall be mounted flush on a wall-mounted box, on Surface Raceway and in Modular Furniture. Information Outlet locations are identified on Project Drawings.
- F. Avoid abrasion and other damage to cables during installation. Any cable damaged during installation shall be removed and a new cable installed.
- G. Cables shall be a continuous run. No in-line splices are permitted except were explicitly indicated on the drawings.

### **3.2. DELIVERY AND STORAGE**

- A. Receive, handle, and store telecommunications system items and materials at the project site. Materials and items shall be so placed that they are protected from damage and deterioration.

### **3.3. INSTALLATION**

- A. The drawings for work under Division 27 Sections related to communication systems are diagrammatic and are intended to convey the scope of work and indicate the general arrangement of conduit, boxes, equipment, termination hardware, fixtures and other work included in the Contract.
- B. The Contractor shall verify all dimensions and clearances before procuring any equipment.
- C. Location of items required by the drawings or specifications not definitely fixed by dimensions are approximate only and exact locations necessary to secure the best conditions and results shall be determined at the site and shall be subject to the approval of the Architect/Telecom Design Engineer.

- D. Follow drawings in laying out work, check drawings of other trades to verify spaces in which work will be installed, and maintain maximum headroom and space conditions at all points.
  - 1. Where space conditions appear inadequate, the Architect/Telecom Design Engineer shall be notified before proceeding with installation.
  - 2. Minor conduit and cable tray rerouting and changes shall be made at no additional cost to the Owner.
  - 3. As necessary, adjust elevations of rack-mounted termination hardware and horizontal wire management panels so as to compensate for rack unit sizes of actual hardware used, as compared to hardware rack unit sizes depicted in Contract Drawings.
- E. Perform all work with skilled mechanics of the particular trade involved in a neat and workmanlike manner.
- F. Perform all work in cooperation and coordination with other trades and schedule.
- G. Furnish other trades advance information on locations and sizes of frames, boxes, sleeves and openings needed for the work, routes for conduit and cable tray raceway, and also furnish information and shop drawings necessary to permit trades affected to install their work properly and without delay.
- H. Where there is evidence that work of one trade will interfere with the work of other trades, all trades shall assist in working out space allocations to make satisfactory adjustments and shall be prepared to submit and revise coordinated shop drawings.
- I. With the approval of the Architect/Consultant and without additional cost to the Owner, make minor modifications in the work as required by structural interferences, by interferences with work of other trades or for proper execution of the work.
- J. Work installed before coordinating with other trades so as to cause interference with the work of such other trades shall be changed to correct such condition without additional cost to the Owner and as directed by the Architect.
- K. Minor changes in the locations of outlets, fixtures and equipment shall be made prior to rough in at the direction of the Architect/Consultant and at no additional cost to the Owner.
- L. Contractor shall cooperate with other trades and coordinate work so that conflicts with other work are eliminated.
- M. Equipment shall be installed with adequate space allowed for removal, repair or changes to equipment. Ready accessibility to removable parts of equipment and to wiring shall be provided without moving other equipment which is to be installed or which is in place. Contractor shall verify measurements. Discrepancies shall be brought to the Architect/Telecom Design Engineer's attention for interpretation.
- N. Determine temporary openings in the buildings that will be required for the admission of apparatus furnished under this Division, and notify the Architect/Consultant accordingly. In the event of failure to give sufficient notice in time to arrange for these openings during construction, assume all costs of providing such openings thereafter.

- O. Location of telecommunication outlets and raceway pathways are approximate and exact locations shall be determined on site.
- P. Contractor shall refer to contract documents for details, reflected ceiling plans, and large scale drawings.

### **3.4. COORDINATION**

- A. The Contractor shall be responsible for the coordination of telecommunications work with the work of all other trades and shall, in preparing the drawings, check the work of other trades in order to avoid possible installation conflicts arising therefrom. It shall be understood that the work shown on the shop drawings has been so coordinated. In the event of conflicts or interference that cannot be resolved in the field, the Contractor shall request a written clarification from the Architect/Consultant.
- B. Coordinate service entrance arrangement with local exchange carrier(s).
  - 1. Meet jointly with local exchange carrier representatives and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
  - 2. Record agreements reached in meetings and distribute to other participants.
  - 3. Adjust arrangements and locations of distribution frames and cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
- C. Where work covered by this Section connects to equipment furnished under other Sections, verify telecommunications work involved in the field and make proper connection to such equipment.

**END OF SECTION 27 00 00**

## **SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1. SUMMARY**

- A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end structured cabling system. This includes grounding and bonding of all passive and active equipment supplied by contractor and owner.
- B. This Section includes grounding of communications systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

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

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NEC, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  - 1. Comply with UL 467.

#### **1.3. RELATED DOCUMENTS**

- A. General and Supplementary Conditions

#### **1.4. RELATED SECTIONS**

- A. Division 26 - Grounding and Bonding
- B. Division 26 - Raceway and Boxes
- C. Division 26 - Wiring Devices
- D. Division 27 - Communications

### **PART 2 - PRODUCTS**

#### **2.1. MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by approved manufacturers listed in Division 26 section, "Grounding and Bonding for Electrical Systems."

## 2.2. GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 26 Section “Conductors and Cables.”
- B. Communications Copper Bonding Conductors: As follows:
  - 1. Telecommunications Bonding Conductor (TBC) and Telecommunications Bonding Backbones (TBB): No. 3/0, stranded copper conductor, insulated.
  - 2. Telecommunications Equipment Bonding Conductor (TEBC): No. 6 AWG, stranded copper conductor, insulated.

## 2.3. CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

## 2.4. COMMUNICATIONS OUTSIDE PLANT DUCT BANK, HANDHOLE AND PULL BOX GROUNDING

- A. The reinforcing steel in the walls of the handholes and manholes shall be bonded together and brazed to the bronze inserts of each section per the manufacturer’s specifications. The ground inserts shall be attached to the steel rebar to provide a point of attachment for the ground wires of bonding ribbon. The inserts shall be bronze, flush mounted, and brazed to the rebar cage of all the sections for the handhole and pull box.
- B. Materials:
  - 1. Bonding Ribbon: Shall be made of annealed solid copper 3/8 inch wide x 1/16 inch thick, tin plated. Provide: INWESCO Cat. 12A55, or equal subject to review.
  - 2. Bonding Ribbon Clamp: Shall be made of soft lead 1/2 inch wide by 1/6 inch thick and shall accept 1/4 inch diameter bolt. Provide: INWESCO Cat. 12A56, or equal subject to review.
  - 3. Fargo Clamp: Shall be cast from copper, silver plated, furnished with copper bolt. Provide: INWESCO Cat. 12A57, or equal subject to review.
  - 4. Ground Inserts: Shall be made of Cast Bronze W/14 Copper Rod. Provide: INWESCO Cat. 12H69, or equal subject to review.

## 2.5. TELECOMMUNICATIONS GROUNDING BUSBAR

- A. Comply with ANSI/TIA-607-B.
- B. Telecommunications Main Grounding Busbar (TMGB): Electro-tin plated copper, minimum 1/4 inch thick by 4 inches wide by minimum 20” long, with holes sized, spaced and in minimum quantities as follows:



1. 5/16" holes at 5/8" spacing, minimum quantity of 27
  2. 7/16" holes at 1" spacing, minimum quantity of 3
  3. Provide longer TMGB as necessary to accommodate quantity of actual bonding connections required in field.
- C. Telecom Grounding Busbar (TGB): Electro-tin plated copper, minimum 1/4 inch thick by 2 inches wide by minimum 12" long, with holes sized, spaced and in minimum quantities as follows:
1. 5/16" holes at 5/8" spacing, minimum quantity of 6
  2. 7/16" holes at 1" spacing, minimum quantity of 3
  3. Provide longer TGB as necessary to accommodate quantity of actual bonding connections required in field, per communications room.

## **PART 3 - EXECUTION**

### **3.1. INSTALLATION**

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bond metallic raceways used for routing of communications bonding conductors, to the communications bonding conductor at each end.

### **3.2. CONNECTIONS**

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
  1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to 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.
- B. Equipment Grounding Conductor Terminations: Use pressure-type grounding lugs.
- C. Tighten screws and bolts for grounding and bonding 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.

- D. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

### 3.3. TELECOMMUNICATIONS GROUNDING AND BONDING

- A. Comply with NEC, ANSI/TIA-607-D and UL 467.
- B. Comply with telecommunications ground details and riser diagrams in Contract Drawings.
- C. Telecommunications Grounding Busbars: TMGB and TMB within facility to provide for telecommunications grounding system.
  - 1. Locate grounding terminals in each telecommunications room.
  - 2. Mount on wall of telecommunications entrance facility, equipment room, and closet, with standoff insulators.
- D. Bonding Conductors:
  - 1. Extend a TBC from TMGB to electrical entrance facility and connect to grounding electrode system.
  - 2. Extend a TBB from TMGB to each TGB.
  - 3. Extend a TEBC from TGB to ground terminals at communication relay racks, wall-mount communication racks and cabinets, primary protection blocks, overhead ladder rack runway systems and cable basket tray systems.
- E. Special Requirements:
  - 1. Bonding conductors shall be insulated copper, sized as noted in Contract Drawings.
  - 2. Bonding conductors shall be installed without splices unless as noted in telecommunications grounding riser diagram, or as approved by Architect because of special circumstances. Where splices are necessary, they shall be accessible. Splices shall be by irreversible compression connectors or by exothermic welding.
- F. Primary Protectors
  - 1. Primary protectors shall be installed on each cable end, in the appropriate building entrance protector.
  - 2. Primary protector enclosure shall be bonded to the building grounding system utilizing a minimum #6 AWG ground wire.
- G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

**END OF SECTION 27 05 26**

## **SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1. SUMMARY**

- A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end structured cabling system. This includes pathways for distribution and protection of cabling and components.

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

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NEC, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467.
- C. General Requirements: Comply with ANSI/TIA-569-D.
- D. Cable Support: NRTL labeled for support of Category 6A cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
  - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
  - 2. Lacing bars, spools, J-hooks, and D-rings.
  - 3. Straps and other devices.
  - 4. Bridle rings not permissible unless furnished with cable saddles.

#### **1.3. RELATED DOCUMENTS**

- A. General and Supplementary Conditions

#### **1.4. RELATED SECTIONS**

- A. Division 26 - Grounding and Bonding
- B. Division 26 - Raceway and Boxes
- C. Division 26 - Wiring Devices
- D. Division 27 – Communications

## **PART 2 - PRODUCTS**

### **2.1. MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by approved manufacturers listed in Division 26 section, "Grounding and Bonding for Electrical Systems."

### **2.2. CONDUIT AND ELECTRICAL BOXES**

- A. Comply with requirements in Division 16 Section "Raceways and Boxes." Flexible metal conduit shall not be used, except as indicated in Contract Drawings. Coordinate with layout and sizing details and requirements as indicated in Contract Drawings.
  - 1. Outlet boxes shall be no smaller than 4 inches wide, 4 inches high and 2-1/8 inches deep.
  - 2. Minimum conduit to telecom outlet locations: Trade Size 1-1/4", unless otherwise noted in Contract Drawings.

### **2.3. COMMUNICATIONS OUTSIDE PLANT HANDHOLE AND PULL BOXES**

- A. Materials:
  - 1. All handholes and pull boxes to be installed shall be specifically designed for telecommunications applications, with no exceptions.
  - 2. The contractor shall provide pre-cast utility vaults meeting ASTM C 478 with 28 day 5500 psi minimum compressive strength concrete and designed for AASHTO H-20 loading per AASTO HB 14. See outside plant drawings for sizes.
  - 3. Utility handholes shall have tongue-and-groove double sealed joints on mating edges of pre-cast components. The joints shall firmly interlock adjoining components and provide waterproof junctions and adequate shear transfer. Joints shall be sealed with approved watertight joint sealant as prescribed in the manufacturer's installation specifications and conforming to AASHTO M198, Type B. Sealing material shall be installed in strict accordance with manufacturer's printed instructions.
  - 4. Conduit entrances:
    - a. For conduit installed on this project, knockout panels or pre-cast individual conduit openings may be used.
    - b. For existing utility vaults, new ducts shall enter the utility vault with factory-formed bell end of the conduit, and a seal around the conduit shall be applied after installation. Existing utility vaults that shall be re-used to install new copper and fiber cables shall be retrofitted with the required racking and grounding and bonding per TIA Bonding and Grounding Standards.
  - 5. Handholes and pull boxes shall be equipped with a minimum of approved cable racking on one long wall suitable to support large copper cables as called for on the design documents.
  - 6. All handholes and pull boxes as shown on the plans shall be equipped with non-skid surface traffic rated spring loaded hinged lids with a locking mechanism.

7. All lids shall have the identification marking of “Communications” permanently affixed to the cover. The upper side of each cover shall have the letters “Communications” cast or burned by welder, in integral letters no less than 2 inches high. The cover shall also be field stamped with two inch high pull box identification numbers determined with the College as final on site.
- B. Provide: Jensen Precast, Utility Vault Company, or equal subject to review.

#### **2.4. COMMUNICATIONS OUTSIDE PLANT HANDHOLE AND PULL BOX HARDWARE**

- A. Materials:
1. Pulling irons shall be provided, as required for the size of handhole and pull box (minimum of 4: 2 installed on each end wall, top and bottom). Pulling irons shall be installed opposite the terminators. All pulling irons shall be constructed of 2.2 cm (7/8 inch) hot-dip galvanized steel.
  2. A sump of 30cm (12 in.) in diameter shall be provided in each handhole and pull box per the manufacturer’s specifications.
  3. Heavyweight cable racks with adjustable arms shall be provided for all cables in each utility vault. The racks shall be attached with adjustable inserts set in the concrete walls (bolts or studs embedded in concrete will not be used). Racks and inserts shall be centered on the side walls that are utilized for the racking of splice cases in the handhole or pull box, arranged so that all spare conduit ends are clear from future cable installation. The racks shall have a sufficient number of arms to accommodate cables for each conduit entering or leaving the utility vault.
  4. Corner standoff brackets 15cm to 20cm (6 inches to 8 inches from wall) shall be provided if the handhole and pull box is equipped with center exit conduits. The bracket shall extend from 15cm (6 inches) off floor to 15cm (6 inches) below roof.
  5. All handhole and pull box hardware shall be steel that is hot dip galvanized after fabrication.
- B. Provide: Alhambra Foundry (Model No. A-3362 ladder with A-3382 support bar), Inwesco products, or equal subject to review.

#### **2.5. COMMUNICATIONS OUTSIDE PLANT DUCT BANKS**

- A. Materials:
1. Conduit – Schedule 40 PVC.
  2. Conduit shall have factory formed bell on one end for interconnecting segments.
  3. All conduits shall be installed in an encased steel pipe where boring method is utilized. Grout shall be provided between conduits inside pipe and around steel pipe to fill voids per manufacturer’s specifications.
  4. Spacers: High impact spacers shall be used in all multi-duct systems. They shall conform to NEMA TC-2, TC-6, TC-8 and ASTM F 512 dimensions.
  5. All fittings shall be designed specifically for use with the type of installed conduit.
  6. All conduits shall be equipped with seal plugs in all handholes and pull boxes and expansion rubber seal plugs within all buildings.
  7. Provide orange dye along entire length of duct bank concrete shell.

- B. Provide: Carlon, Jack Moon, or equal subject to review.
- C. Warning tape shall be a minimum of 3” wide, orange in color, and shall have a non-degradable imprint as follows.
  - 1. “Caution Telephone Cable Buried Below”
  - 2. “Caution Fiber Optic Cable Buried Below”
- D. Provide: Carlon MAT3T61, MAT3061, or equal subject to review.

## **2.6. WIRE BASKET CABLE TRAY**

- A. Wire basket cable tray shall have the following characteristics:
  - 1. Minimum 12” wide and 4” deep unless otherwise noted.
  - 2. Galvanized steel finish.
  - 3. Provide all accessories for achieving cable bend radius including but not limited to waterfall units and radius at turn junctions.
  - 4. Provide GS Metals, Flextray, B-Line or equal subject to review.

## **2.7. SOLID BOTTOM CABLE TRAY**

- A. Solid bottom cable tray shall have the following characteristics:
  - 1. Minimum 12” wide and 4” deep unless otherwise noted.
  - 2. Galvanized steel finish.
  - 3. Tray must be able to be painted or powder coated the same color and material as neighboring in ceiling utilities.
  - 4. Cable must be protected during painting to where it does not get stained. Paint on cable may be grounds for voiding solution warranty.
  - 5. Provide B-Line, Homaco, Square D, or equal subject to review.

## **2.8. J-HOOKS**

- A. Must be metal construction and shall provide a cable support hanger in a “J” configuration designed to support multiple communications cables.
- B. No more than twelve (12) station cables may be supported by a single hanger without using a saddle (3 inches wide at a minimum) to support the weight of the additional cables.
- C. Larger types of wire hangers (larger J-hooks or Tri-hooks) are acceptable for locations requiring more than twelve cables. Copper and fiber cables must be properly installed per manufacturer’s specifications to insure maximum cable performance.
- D. Provide: CPI Chatsworth Products Inc., Cooper B-line, Caddy or equal subject to review.

## **2.9. LADDER RACK**

- A. Cable runway shall be ladder type and designed for use in telecommunications rooms.
- B. Cable runway shall be aluminum construction, minimum 12" wide and 1.5" side rails.
- C. Provide all parts and pieces to create a continuous pathway for cables within telecommunication rooms. Provide parts to support cable continuously from the sleeves entering the TR to the equipment racks and backboards.
- D. Finish should be powder coated, black.
- E. Provide: CPI Chatsworth Products Inc., Cooper B-line, Homaco or equal subject to review.

## **2.10. FLEXIBLE NON-METALLIC INNERDUCT (PLENUM AND RISER)**

- A. Innerduct shall be corrugated plastic.
- B. Nominal duct size shall be minimum 1-inch.
- C. Innerduct shall be riser, plenum, or OSP rated as required by the installation environment.
- D. Provide: Carlon, Vickmatic Plenum Duct or equal subject to review.

## **2.11. INNERDUCT (OUTSIDE PLANT)**

- A. Interbuilding fiber cables in underground duct banks shall be installed in MaxCell innerducts.
- B. Innerduct shall be fabric type with three (3), 3 inch diameter cells unless otherwise notes on the drawings.

## **2.12. CABLE TIES**

- A. Bundle and support all cables and to provide a neat and orderly cabling installation.
- B. Velcro tie wraps shall be used in MDF and IDF Rooms. Zip ties and wraps that cannot be adjusted once installed are not acceptable.
- C. Provide: Velcro, T&B, Hellerman Tyton or equal subject to review.

## **2.13. DISTRIBUTION RINGS (D-RINGS).**

- A. Must be used to support and dress out cables on plywood backboards vertically and horizontally. Cables shall not be supported by cable ties alone on backboard.

- B. Individual D-rings shall be sized to allow a minimum of 50 percent spare capacity for future cable installation.

## **2.14. FIRE RATED CABLE PATHWAYS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. 3M
  - 2. STI
- B. Use only firestopping products that have been tested for specific fire resistance rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate instance.
- C. Vertical Pathway: Pre-manufactured modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill.
- D. Horizontal Pathway: Pre-manufactured modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill.
- E. Firestop Putty: Intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds

## **PART 3 - EXECUTION**

### **3.1. GENERAL**

- A. Cable shall be neatly dressed out in telecom rooms.
- B. Secure cabling with Velcro type cable wraps only.
- C. Install distribution rings on plywood backboards to support cables.

### **3.2. CABLE TRAY**

- A. Install cable trays level, straight, and parallel to walls.
- B. Support cable trays minimum every 5 feet.
- C. Install cable tray system with 12 inches clearance measured from top most surface of tray. Access from sides shall be 6 to 12 inches. Install with 12 inches clearance measured from bottom of tray.
- D. Remove burrs and sharp edges from cable trays.
- E. Cut cable tray wires in accordance with manufacturer's instructions.



- F. Cable tray wires must be cut with side-action bolt cutters with offset head to ensure integrity of protective galvanic layer.
- G. Provide conduit to tray fitting at each conduit entrance to tray.
- H. Ground cable trays according to manufacturer's written instructions.
- I. Cable trays shall not pass through any firewall or fire-rated soffits without proper firestop pillows per applicable codes.
- J. Provide necessary supports and accessories for cable trays as required to make a complete job.

### **3.3. LADDER RACK**

- A. Provide dropouts at all equipment rack and backboard locations.
- B. Install straight, level and perpendicular to walls and ceiling.
- C. Install 3" to 6" above racks.
- D. Cables shall be secured to the runway using reusable cable ties to arrange cable in logical bundles.
- E. Ground cable runway according to manufacturer's written instructions.

### **3.4. J-HOOKS**

- A. Provide J-hooks to support communications cables at locations where cable tray and/or conduit is not provided.
- B. Provide J-hooks assemblies on 4-foot intervals to support all outlet cables. Install J-hooks approximately 12 inches above lay-in ceiling. Use J-hooks to support not more than 50 cables per hook. Provide additional hooks in rows as required to support more than 50 cables.
- C. Individual J-hooks shall be a minimum of 1" in width and sized and arranged to allow a minimum of 50 percent spare capacity for future cable installation.
- D. Secure J-hooks to concrete slab using threaded expansion anchor bolts. Drill slab and install expansion bolt.
- E. Coordinate location with HVAC duct and lights. Do not install above fluorescent lighting fixtures.

### **3.5. FLEXIBLE NON-METALLIC INNERDUCT**

- A. Innerduct segments shall be spliced using couplings designed for that purpose.
- B. All vacant innerduct shall be equipped with a pull cord and capped at both ends.
- C. Innerduct shall extend to the ladder rack above the termination enclosure.
- D. All exposed innerduct shall be labeled at 50-foot intervals with tags indicating the cable type it contains.

### **3.6. FIRE RATED CABLE PATHWAYS**

- A. Install through-penetration firestop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.
- B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of firestopping products.
- C. Where deficiencies are found, repair firestopping products so they comply with requirements.
- D. Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses.

**END OF SECTION 27 05 28**

## **SECTION 27 08 00 - COMMISSIONING OF COMMUNICATIONS SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1. SUMMARY**

- A. The work covered under this Section shall consist of a testing, documenting, and commissioning of an operable end to end structured cabling system.
- B. Complete installation shall comply with the campus or owner's latest telecommunication and IT standards documents.

#### **1.2. RELATED SECTIONS**

- A. Division 27

#### **1.3. PROJECT AS-BUILT AND CLOSEOUT DOCUMENTS**

- A. Accurately record exact sizes, locations, heights and quantities of cables and Information Outlets.
- B. As-built drawings shall indicate all final cable routes and final outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons and drawing conventions used shall be consistent throughout all documentation provided.
- C. Drawings shall indicate final TR & ER locations along with their final build out conditions at end of the project.
- D. Submit bound folders of product used in the project for record.
- E. Submit cable tester calibration reports.
- F. Submit all copper and fiber optic test results as indicated in Part 3 of this specification. This should include every cable channel installed in the project.
- G. Plans shall be provided in full size PDF, AutoCAD or REVIT format within a CD or DVD along with hard copies.

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

## **PART 3 - EXECUTION**

### **3.1. GENERAL**

- A. Contractor shall follow standard industry installation practices as described in the latest release of the BICSI TDMM.

### **3.2. IDENTIFICATION AND LABELING**

- A. All backbone and station cables, faceplates and termination components shall be clearly labeled in accordance with ANSI/TIA 606-C.
- B. The Contractor shall obtain the labeling scheme from the Owner.
- C. Labels strips shall be covered with a protective plastic coating. Labels shall be machine printed. No handwritten label shall be accepted. Stick-on labels are not acceptable.
- D. Components
  - 1. The labeling made for each component should be:
    - a. Unique, to prevent confusion with similar components.
    - b. Legible and permanent enough to last the lifecycle of the component.
    - c. The following infrastructure components should be labeled:
      - 1) Telecommunications spaces
      - 2) Telecommunications pathways
      - 3) Telecommunications cables
      - 4) Zone boxes
      - 5) Connecting hardware
      - 6) Grounding (earthing) system
- E. Telecommunications spaces
  - 1. Telecommunications spaces include:
    - a. Equipment rooms (ERs)
    - b. Telecommunication rooms (TRs)
    - c. Telecommunication enclosures (TEs)
    - d. Work areas
  - 2. Spaces should be labeled at their entrances, as follows:
    - a. In small, single-story buildings, a simple sign on the door is sufficient.
    - b. In larger buildings, the labeling should provide a unique identifier, since there may be a number of telecommunications spaces.

F. Telecommunications pathways

1. Labeling of pathways helps prevent inadvertent installation of cables from systems that may interfere with each other.
2. When labeling pathways, the following guidelines should be met:
  - a. Labeling should be affixed at the ends of each pathway.
  - b. Pathways should be labeled at regular intervals and wherever they are accessible.
  - c. In a basic system, the conduits should be marked from the main ER by painting or using a permanent-colored tape-wrap made for this purpose.
  - d. In systems utilizing zone boxes for consolidation or distribution of low-voltage systems, each box label should include the information about the room of origin and system usage.
  - e. In complex systems or large buildings:
    - 1) A striped tape should wrap pathways with the base color identifying them as telecommunications pathways and tracer color identifying the individual uses.
    - 2) Each pathway should be assigned a unique alphanumeric identifier.
    - 3) All wall or floor penetrations should be labeled.
3. Telecommunications cables
  - a. When labeling telecommunications cables:
    - 1) Cables should be identified at each end with a permanent label or physical/electronic tag. The same alphanumeric identifiers should be used at both ends of the cable.
    - 2) Cable should be identified at regular intervals throughout its length with its alphanumeric identifier when cables are rearranged, rerouted, or removed in spite of the added cost.
  - b. In systems that are:
    - 1) Basic, the labeling scheme can be a simple number sequence.
    - 2) Complex, the labeling may indicate the type, function, and terminating position.

G. Connecting hardware

1. Connecting hardware items (e.g., cross-connect fields and telecommunications outlet/connectors) require a unique, alphanumeric identification such as the following three-level scheme:
  - a. First level – Termination field or patch panel. Color-coding or other labeling should be used to uniquely identify each termination field on a common mechanical assembly.
  - b. Second level – Terminal block within a given field or patch panel, which could be a row of insulation displacement connectors (IDCs), optical fiber connectors, or modular jacks.
  - c. Third level – Defines the individual position within a given terminal block or patch panel.

- H. Grounding (Earthing)
1. Grounding system components (e.g., ground bars and grounding conductors) require special labeling for safety and noise control purposes and for simplifying and expediting ground system audits.
  2. All equipment grounding conductors should be labeled to indicate the:
    - a. Grounded rack, cabinet, or shelf.
    - b. Ground bar to which the grounding conductors are connected.
  3. Each grounding conductor in a building should be labeled, including those connecting building steel, grounding electrodes, water pipes, radio towers, and telecommunications structural components.

### 3.3. TESTING AND COMPLIANCE

- A. The Contractor is responsible for supplying all equipment and personnel necessary to conduct the acceptance tests. Testing shall be executed by technicians holding proof of successful installation certification from the system manufacturer.
- B. Cable testers are to be calibrated within four (4) months of use.
- C. Prior to testing, the Contractor shall provide a summary of the proposed test plan for each cable type including equipment to use, set-up, test frequencies or wavelengths, results format, etc.
- D. 100 percent of the installed cabling links must be tested in accordance with ANSI/TIA-568-D standard and must pass the requirements described under the heading for each cable type. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation.
- E. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (\*) when the result is closer to the test limit than the accuracy of the field tester. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests. Any Fail or Fail\* result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass or Pass\*.
- F. The Contractor shall conduct acceptance testing according to a schedule coordinated with the Owner. Representatives of the Owner shall be invited to be in attendance to witness the test procedures. The contractor shall provide a minimum of one (1) week advance notice to the Engineer as to allow for such participation. The notification shall include a written description of the proposed conduct of the tests including copies of blank test result sheets to be used.
- G. A representative of the end-user shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase 5 business days before testing

commences. A representative of the Owner reserves the right to select a random sample of up to 5 percent of the installed links for retesting. The Contractor shall re-test these randomly selected links and the results are to be stored in the tester. The results obtained shall be compared to the original test data provided by the Contractor. If more than 2 percent of the sample pass/fail results differ from the original test data, the installation contractor under supervision of the Owner's representative shall repeat 100 percent testing and the cost shall be borne by the Contractor.

### **3.4. CABLING ADMINISTRATION DRAWINGS**

- A. Prepare Cabling Administration Drawings showing building floor plans with cable administration-point identification labeling. Depict all telecommunications outlets and their associated label, provide callouts indicating locations of telecom rooms and spaces and, where applicable, indicate zone line demarcations denoting areas served by each respective telecom room. Coordinate drawing features with shop drawing requirements outlined in Section 270000.
- B. Prepare Drawings for use as part of cabling installation work. Periodically update Drawings to reflect constructed conditions, including any moves, changes or additions to the communications infrastructure. At completion, Cabling Administration Drawings shall reflect as-built conditions.
- C. Interim Submission: Issue two (2) half-size printed copies of in-progress draft Cabling Administration Drawings to Owner no later than five (5) weeks prior to Substantial Completion, for Owner's use in preparation of patch schedules and to support other internal move-in planning processes. Coordinate exact timing with Owner's IT personnel.

### **3.5. TEST RESULTS DOCUMENTATION**

- A. The test results information for each link shall be recorded in the memory of the field tester upon completion of the test. The test result records saved by the tester shall be transferred into a spreadsheet or database that allows for the maintenance, inspection and archiving of these test records. Provide the database for the completed job on CD-ROM. If the results cannot be viewed by Microsoft Excel or Microsoft Access, the Contractor shall provide one licensed copy of a software package suitable to view and print reports of the test results.
- B. Upon completion of the installation, the contractor shall provide three (3) full electronic documentation sets to the Consultant for approval.
- C. Documentation shall be submitted within ten (10) working days of the completion of the testing phase. This includes draft as-built drawings. Draft drawings may include annotations done by hand.
- D. Machine generated final copies of all drawings shall be submitted within 30 working days of the completion of the testing phase. Final copies shall have all annotations in CAD format.
- E. All documentation, including hard copy and electronic forms shall become the property of the Owner.

- F. A paper copy of the test results shall be provided that lists all the links that have been tested along with the following summary information:
1. The identification of the customer site as specified by the end-user.
  2. The identification of the link in accordance with the naming convention defined in the overall system documentation.
  3. The overall Pass/Fail evaluation of the link-under-test.
  4. The date and time the test results were saved in the memory of the tester.
- G. The following information shall be provided in the electronic database of the test results information for each link:
1. The identification of the customer site as specified by the end-user.
  2. The identification of the link and/or fiber in accordance with the naming convention defined in the overall system documentation.
  3. The overall Pass/Fail evaluation of the link-under-test.
  4. The date and time the test results were saved in the memory of the tester.
  5. The name of the standard selected to execute the stored test results.
  6. The cable type and the value of NVP or index of refraction used for length calculations.
  7. The brand name, model and serial number of the tester.
  8. The identification of the tester interface.
  9. For fiber tests, the identification of each link/fiber in accordance with the naming convention defined in the overall system documentation
  10. For fiber tests, the insertion loss (attenuation) measured at each wavelength, and the test limit calculated for the corresponding wavelength.
  11. For fiber tests, the link length shall be reported for each optical fiber for which the test limit was calculated based on the formulas above.
  12. The revision of the tester software and the revision of the test standards database in the tester.
- H. The test results information must contain information on each of the required test parameters in accordance with the descriptions above. For each of the frequency-dependent test parameters, the value measured at every frequency during the test shall be reported.

### **3.6. CATEGORY 6A CABLING**

- A. Each category 6A cabling link in the installation shall be tested in accordance with the field test specifications defined in ANSI/TIA-568-D.
- B. In order to pass the test all measurements (at each frequency in the range from 1 MHz through 500 MHz) must meet or exceed the limit value determined in the above-mentioned standard.
- C. The test equipment (tester) shall comply with the accuracy requirements for level IIIe field testers as defined in ANSI/TIA-1152-A. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table 4 of ANSI/TIA-1152-A.



- D. The following parameters shall be tested for each cable:
1. Wire Map – Shall report Pass if the wiring of each wire-pair from end to end is determined to be correct. The Wire Map results shall include the continuity of the shield connection if present.
  2. Length – The field tester shall be capable of measuring length of all pairs of a basic link or channel based on the propagation delay measurement and the average value for NVP (1). The physical length of the link shall be calculated using the pair with the shortest electrical delay. This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the Permanent Link configuration (90 meters – 295 feet) plus 10 percent to allow for the variation and uncertainty of NVP.
  3. Insertion Loss (Attenuation) – Insertion Loss is a measure of signal loss in the permanent link or channel. The term “Attenuation” has been used to designate “Insertion Loss.” Insertion Loss shall be tested from 1 MHz through 500 MHz in maximum step size of 1 MHz. It is preferred to measure insertion loss at the same frequency intervals as NEXT Loss in order to provide a more accurate calculation of the Attenuation-to-Crosstalk ratio (ACR) parameter. Minimum test results documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results for the worst wire pair must show the highest attenuation value measured (worst case), the frequency at which this worst case value occurs, and the test limit value at this frequency.
  4. NEXT Loss – Pair-to-pair near-end crosstalk loss (abbreviated as NEXT Loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations). This parameter is to be measured from 1 through 500 MHz. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair. The maximum step size for NEXT Loss measurements shall not exceed the maximum step size defined in the standard. Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case NEXT margin (2) and the wire pair combination that exhibits the worst value of NEXT (worst case). NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
  5. PS NEXT Loss – Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link under-test (a total of eight results). PS NEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when all other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 through 500 MHz and the step size may not exceed the maximum step size defined in the standard. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PS NEXT. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
  6. ACR-F, pair-to-pair – Attenuation Crosstalk Ratio Far-end is calculated from the pair-to-pair FEXT Loss. It shall be measured for each wire-pair combination from both ends of the link under-test. FEXT Loss measures the crosstalk disturbance on a wire pair at the opposite end (far-end) from which the transmitter emits the disturbing signal on the disturbing pair. FEXT is measured to compute ACR-F Loss that must be evaluated and reported in the test results. ACR-F measures the relative strength of the

far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire pair combinations. ACR-F is to be measured from 1 through 500 MHz and the maximum step size for FEXT Loss measurements shall not exceed the maximum step size defined in the standard. Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ACR-F. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

7. PS ACR-F Loss – Power Sum Attenuation Crosstalk Ratio Far-end is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs on the fourth one. This test yields eight wire-pair combinations. Each wire-pair is evaluated from 1 through 500 MHz in frequency increments that do not exceed the maximum step size defined in the standard. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst pair combinations must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
8. Return Loss – Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured from 1 through 500 MHz in frequency increments that do not exceed the maximum step size defined in the standard. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for Return Loss. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
9. Propagation Delay – Propagation delay is the time required for the signal to travel from one of the link to the other. This measurement is to be performed for each of the four wire pairs. Minimum test results documentation (summary results): Identify the wire pair with the worst-case propagation delay. The report shall include the propagation delay value measured as well as the test limit value.
10. Delay Skew – This parameter shows the difference in propagation delay between the four wire pairs. The pair with the shortest propagation delay is the reference pair with a delay skew value of zero. Minimum test results documentation (summary results): Identify the wire pair with the worst-case propagation delay (the longest propagation delay). The report shall include the delay skew value measured as well as the test limit value.
11. PS ANEXT – Pair-to-pair Alien NEXT (ANEXT) contributions is measured by applying the stimulus signal at the near end to one wire pair of a disturbing link and measuring the coupled signal at the near end of a wire pair in a disturbed link. This process is repeated for every wire pair in a disturbing link. The PS ANEXT for each wire pair in a disturbed link is obtained by the power sum addition of all the pair-to-pair ANEXT results to that wire pair from all wire pairs in disturbing links. All the links that are bundles with the disturbed link need to be included as disturbing links. In addition, links that are terminated in adjacent positions in a patch panel or interconnect panel should also be included as disturbing links in this test. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PS ANEXT.

These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

12. PS AACR-F – The pair-to-pair Alien Far End crosstalk (AFEXT) contributions is measured by applying the signal at the near end to one wire pair of a disturbing channel or permanent link and measuring the coupled signal at the far end of a wire pair in a disturbed channel or permanent link. This process is repeated for every wire pair in a disturbing link and for all links in close proximity. A normalization, which is dependent on the relative length of disturbing and disturbed link, is applied to each pair-to-pair alien FEXT measurement. Then the PS Alien Attenuation-to-Crosstalk Ratio from the Far end (PS AACR-F) for each wire pair in a disturbed channel or permanent link is obtained by the power sum addition of all the normalized pair-to-pair far end alien crosstalk results to that wire pair from all wire pairs in disturbing links in close proximity. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PS AACR-F. If the link or channel connects two patch panels (data center), these wire pairs must be identified for the tests performed from both ends. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

Frequency Range (MHz)	Maximum Step size (MHz)
1 – 31.25	0.15
31.26 – 100	0.25
100 – 250	0.50
250 – 500	1.00

- E. In addition to testing the “In-link” performance parameters detailed in D above, Alien Crosstalk testing or “Between-link” testing shall be carried out in accordance with Section 4.7 of ANSI/TIA-1152-A. Alien crosstalk testing includes the PS ANEXT and PS AACR-F (Power sum alien attenuation-to-crosstalk ratio from the far end) performance parameters. The standards refer to the link-under-test for Alien Crosstalk as the disturbed link.
- F. PS ANEXT and PS AACR-F shall meet or exceed the limits defined in Section 6 of the TIA Cat 6A Standard.
- G. Selection of disturbed links: 1 percent of the links in the cabling installation or 5 links, whichever is more. Chose short, medium and long links equally.
- H. Selection of disturber links. Select all of the links that are in the same cable bundle and the most consistently positioned relative to the disturbed link as disturbing links.
- I. If the margin of PS ANEXT and PS AACR-F exceeds 5 db for the first three short, medium and long links (nine in total), further alien crosstalk testing can be discontinued.

### 3.7. BACKBONE COPPER CABLE TESTING

- A. Backbone Voice cables shall be free of shorts within the pairs, and be verified for continuity, pair validity and polarity and conductor position on the termination blocks. Any incorrectly positioned pairs must be identified and corrected. The percentage of “bad” pairs shall not exceed 3 percent in any backbone cable based on total pair count. All bad pairs must be identified and documented.
- B. The Contractor shall be responsible to test the entire system from each voice outlet to the building Main Cross-connect (MC). If more than a 1 percent failure on the cross-connects occur the contractor will be required to provide mapping of the system.

### 3.8. FIBER OPTIC CABLE TESTING

- A. Every fiber optic cabling link in the installation shall be tested in accordance with the field test specifications defined by the Telecommunications Industry Association (TIA) standard ANSI/TIA-568-D.
- B. ANSI/TIA-568-D, defines the passive cabling network, to include cable, connectors, and splices, between two optical fiber patch panels. A typical horizontal link segment is from the telecommunications outlet/connector to the horizontal cross-connect. The test shall include the representative connector performance at the connecting hardware associated with the mating of patch cords. The test does not, however, include the performance of the connector at the interface with the test equipment.
- C. 100 percent of the installed cabling links shall be tested. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation.
- D. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by the manufacturer of the fiber optic cable and/or the fiber optic connectors or the manufacturer of the test equipment used for the field certification.
- E. Field test instruments for multimode fiber cabling shall meet the requirements of ANSI/TIA-526-14-B. The light source shall meet the launch requirements of ANSI/TIA-455-50B, Method A. This launch condition can be achieved either within the field test equipment or by use of an external mandrel wrap with a Category 1 light source.
- F. Field test instruments for single mode fiber cabling shall meet the requirements of ANSI/TIA-526-7.
- G. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
- H. The fiber optic launch cables and adapters must be of high quality and the cables shall not show excessive wear resulting from repetitive coiling and storing of the tester interface adapters.

- I. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests.
- J. ANSI/TIA standard 568-D prescribes that the single performance parameter for field testing of fiber optic links is insertion loss. The insertion loss shall be calculated by the following formulas specified in ANSI/TIA standard 568-D:
  - 1. Link Attenuation = Cable\_Attn + Connector\_Attn + Splice\_Attn
  - 2. Cable\_Attn (dB) = Attenuation\_Coefficient (dB/km) \* Length (Km)
  - 3. The values for the Attenuation\_Coefficient are listed in the table below:

Type of Optical Fiber	Wavelength (nm)	Attenuation Coefficient (dB/km)
Multimode 50/125 μm	850	3.0
	1300	1.0
Single-mode (Inside plant)	1310	0.5
	1383	0.5
	1550	0.5
Single-mode (Outside plant)	1310	0.5
	1383	0.5
	1550	0.5

- 4. Connector\_Attn (dB) = number\_of\_connector\_pairs \* connector\_loss (dB)
  - 5. Maximum allowable individual connector\_loss = 0.75 dB
  - 6. Splice\_Attn (dB) = number of splices (S) \* splice\_loss (dB)
  - 7. Maximum allowable splice loss = 0.3 dB
- K. Additional 40GB/100GB requirements for multimode fiber:
  - 1. Maximum MPO and individual connector loss = .35 dB.
  - 2. Maximum total connector loss per 150 meters = 1dB
  - 3. Maximum total channel insertion loss per 150 meters = 1.5dB
- L. Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices, i.e., link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
- M. Link test limits attenuation are based on the use of the One Reference Jumper Method specified by ANSI/TIA-526-14A, Method B and ANSI/TIA-526-7, Method A.1
- N. The acceptable link attenuation for a multimode horizontal optical fiber cabling system is based on the maximum 90 m (295 ft) distance. The horizontal link should be tested at 850 nm or 1300 nm in one direction in accordance with ANSI/TIA-526-14A, Method B, One Reference Jumper. The horizontal link shall be tested using a fixed upper limit for attenuation of 2.0 dB.
- O. Multimode backbone links shall be tested in one direction at 850 nm and 1300 nm in accordance with ANSI/TIA-526-14A. The link attenuation equation above shall be used to determine limit values.

- P. Single mode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA-526-7, Method A.1, One Reference Jumper. All single mode links shall be certified with test tools using a Category 2 laser light sources at 1310 nm and 1550 nm.

### **3.9. COAX CABLE TESTING**

- A. A Time Domain Reflectometer (TDR) shall be used to verify cable length and to test for cable faults and breaks. A step-function high resolution Time Domain Reflectometer shall be employed for this test. The TDR will sweep the cable at a rate no greater than 50' per second, or such lower rate as necessary to resolve cable faults to the 1" and .001 VRC level.
- B. The cables shall be terminated with its characteristic impedance, and in the case of nominal 75 ohm cable, an appropriate matching pad shall be used to match the analyzer to the cable. Cable shall be rejected if any single fault is observed of amplitude greater than .003 voltage reflection coefficient. Characteristic impedance shall also be measured at 5% of nominal value.
- C. Cyclic faults (such as cable reel stress and die drawdown) shall be limited to a voltage reflection coefficient of .005.

### **3.10. WARRANTY**

- A. The Contractor shall guarantee all materials, equipment, etc., for one year from date of substantial completion of this work. This guarantee shall include all labor, material and travel time. This warranty is in addition to the cabling system manufacturer's warranty.

**END OF SECTION 27 08 00**

## **SECTION 27 11 00 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS**

### **PART 1 - GENERAL**

#### **1.1. SUMMARY**

- A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end structured cabling system. Including equipment for the Telecom Rooms.

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

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NEC, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

#### **1.3. RELATED DOCUMENTS**

- A. General and Supplementary Conditions

#### **1.4. RELATED SECTIONS**

- A. Division 26 - Grounding and Bonding
- B. Division 27 - Communications

### **PART 2 - PRODUCTS**

#### **2.1. MANUFACTURER(S) AND SOLUTIONS**

- A. Acceptable manufacturers:
  - 1. CPI Chatsworth Products Inc.

#### **2.2. EQUIPMENT RACK**

- A. Standard Floor-Mounted 19" Rack: Aluminum or steel construction, freestanding, modular, with top and bottom angles.
- B. Rack shall be 84" high and accommodate industry standard 19" wide mounting brackets.
- C. Rack shall incorporate a universal 5/8"-5/8"-1/2" alternating hole pattern.
- D. Rack rails shall be threaded and tapped to accept industry standard #12-24 mounting screws.

- E. Rack should be supplied with a ground bar and #6 AWG Ground lug.
- F. Equipment Rack shall be equipped with cable management hardware to provide for orderly and secure routing of cabling. Provide cable management as described in the specifications and drawings.

### **2.3. HORIZONTAL CABLE MANAGEMENT**

- A. Horizontal cable manager shall be slotted duct with removable cover. Manager shall be a minimum of 2 rack units high and suitable for mounting in a standard 19" wide rack.
- B. Provide strain relief and cable management at the rear of each manager unit for clean routing of all cables.
- C. Management shall be Black in color.

### **2.4. VERTICAL CABLE MANAGEMENT**

- A. Vertical cable manager shall be slotted duct with removable cover. Wires should be held in place after cover is removed. Finger spacing shall be on 1U centers. Manager shall have integral cable pass thru holes for ease of front to back cabling. Management shall be provided for front and back of rack.
- B. Management shall be side mounted on both sides of each rack and/or cabinet as shown on drawings.
- C. Length of management shall match overall height of rack and 6" minimum width unless otherwise noted.
- D. Management shall be Black in color.

### **2.5. TELECOMMUNICATIONS PLYWOOD BACKBOARD**

- A. Backboards shall be 4'W x 8'H x 3/4"D, finished grade.
- B. All sides of each backboard should be painted with two coats of white fire retardant paint prior to installation.
- C. If the local authority having jurisdiction of fire code requires fire-rated plywood, then UL listed fire retardant plywood should be utilized and painted with white fire retardant paint prior to installation.
- D. A fire retardant paint additive may be used and the associated documentation should be applied to the painted backboard as proof of usage.



## 2.6. POWER DISTRIBUTION UNIT (PDU)

- A. PDU inlet cord shall include the appropriate plug deemed necessary (e.g. 5-20P, L6-30P) per the electrical drawings. Refer to the electrical drawings for more information on plug type for dedicated power receptacles above the equipment racks and cabinets or elsewhere in the room.
- B. Inlet cord shall be a minimum 12 feet in length.
- C. Horizontal PDU, Type 1 – 120VAC/20A PDU shall include a minimum of (16) switched NEMA 5-15R/5-20R power outlets in a 1U horizontal rack-mount form factor.
- D. Horizontal PDU, Type 2 – 208VAC/30A PDU shall include a minimum of (8) switched C13 and (6) C19 power outlets in a 2U horizontal rack-mount form factor.
- E. PDU shall have metered and switched functionality.
- F. Each outlet on PDU shall support power-on, power-off and reboot on a real-time programmable basis.
- G. Unit shall allow reporting of voltage, frequency & load level, and current via Ethernet interface. Notifications of conditions are to be reported by email, secure web, SNMP, Telnet or SSH interface.
- H. PDU shall provide Transient suppression to avoid overloads per the wattage rated by the PDU overall and by the individual power outlets.
- I. UL-1449, UL 1283 and UL-497A compliant.
- J. Power strip shall meet or exceed IEEE 587 Category A & B specifications.
- K. One (1) Horizontal PDU, Type 1 shall be furnished and installed in each rack within the room in coordination with the Owner.
  - 1. Tripp-Lite PDUMH20NET or equal subject to review.
- L. One (1) Horizontal PDU, Type 2 shall be furnished and installed in each rack within the room in coordination with the Owner.
  - 1. Tripp-Lite PDUMH30HV19NET or equal subject to review.

## PART 3 - EXECUTION

### 3.1. EQUIPMENT RACK

- A. The Contractor shall bolt the rack to the floor as recommended by the manufacturer. Multiple racks shall be joined and the ground made common on each. Rack shall also be stabilized by extending a brace to the wall. Alternately, overhead cable tray over which the cabling accesses the equipment rack(s) shall provide this function.

- B. Install rack with 4" side clearance from walls. Provide minimum clearances as shown on Drawings. Locations where these guidelines cannot be followed should be brought to the attention of the Consultant prior to installation.
- C. Install with a minimum of 36 inches clear access behind and in front of rack unless otherwise directed by drawings.
- D. Install racks straight and perpendicular to walls.
- E. All hardware and equipment shall be mounted above 18" and below 79" A.F.F.
- F. The rack shall be grounded to the telecommunications ground bar (TGB) using a minimum #6 AWG insulated stranded copper conductor. Conductor jacket shall be green.

### **3.2. WIRE MANAGEMENT**

- A. Rack shall be equipped with vertical and horizontal wire management hardware.
- B. Provide horizontal cable management hardware below each patch panel.
- C. Provide vertical cable management hardware on front and rear of each rack. Where multiple racks are installed, troughs shall be mounted between the uprights of adjacent racks per manufacturer recommendations.

### **3.3. BACKBOARDS:**

- A. Install backboards 6" above the finished floor to 8'6" AFF. Mounting shall be sufficient enough to support the equipment.
- B. Shall be mounted with a minimum of 3/8" toggle bolts and 2" fender washer on each corner and 4' on center as required.

**END OF SECTION 27 11 00**

## **SECTION 27 13 00 - COMMUNICATIONS BACKBONE CABLING**

### **PART 1 - GENERAL**

#### **1.1. SUMMARY**

- A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end backbone structured cabling system throughout the campus and premises. This includes - but is not limited to - furnishing and installing cable, cable supports, cable ties, innerduct and termination components, ancillary equipment, testing, labeling and documentation of cables and connectors.
- B. Complete product procurement and installation shall comply with the campus or owner's latest telecommunication and Information Technology standards documents.

### **PART 2 - PRODUCTS**

#### **2.1. MANUFACTURER(S) AND SOLUTIONS**

- A. Acceptable backbone voice copper (interbuilding) manufacturers:
  - 1. General Cable, or Belden
- B. Acceptable fiber optic (interbuilding) manufacturers:
  - 1. Corning LANscape.

#### **2.2. BASIC ENVIRONMENTAL REQUIREMENTS**

- A. Cabling shall be suitable for environment in which they are to be installed.
- B. Cabling shall be plenum-rated within interior premise installations.
- C. Cabling shall be outdoor rated within exterior installations subject to outdoor environmental conditions.

#### **2.3. INTERBUILDING COPPER CABLING (VOICE)**

- A. Cables shall incorporate 24 AWG solid, annealed, bare copper conductors insulated with a polyvinyl chloride skin over expanded polyethylene.
- B. Conductors shall be twisted to form pairs and fully color-coded. Cable shall be available in 25, 50, 100, 200 or more pairs.

- C. Cables shall be designated RUS/REA PE-89 suitable for duct or direct burial applications. Cables shall be Aluminum Steel with Polyethylene (ASP) filled core cables.
- D. Conductors shall be insulated with a thermoplastic skin. Maximum diameter of the insulated conductor shall be 0.048 in (1.22 mm). Insulated conductors shall be stranded into pairs of varying lengths in order to minimize cross-talk.
- E. Conductors shall be identified by the insulation color of each conductor. The color code shall follow the industry standard composed of ten (10) distinctive colors to identify 25 pairs in accordance with the latest ICEA publication of S-80-576.
- F. When cables of larger than 25 pairs are required, the core shall be assembled into 25-pair sub-units. Cables with over 600 pairs shall have 25-pair binder groups combined into super units. These super units shall be wrapped with a solid color thread that follows the primary color scheme of white, red, black, yellow and violet. Binder color code integrity shall be maintained wherever cables are spliced.
- G. Cable shall meet the physical and electrical requirements of 100 Ohm twisted pair cable as defined by standards. Cable shall conform to Category 3 performance specifications or better.
- H. A flooding compound shall be applied over the core and to all surfaces of the shield/armor to resist moisture entry and to inhibit corrosion.
- I. The cable core shall be filled with a waterproofing compound and wrapped with a non-hydroscopic core tape.
- J. The cables shall contain an overall corrugated, coated aluminum shield, which is electrically continuous over its entire length.
- K. The cable shall be finished with a polyethylene jacket, which is sequentially printed with a footage marker at regular intervals.

#### **2.4. VOICE TERMINATION FIELD**

- A. Voice terminations shall utilize 110 style termination hardware with 25 pairs per row.
- B. The mechanical termination shall be capable of terminating 22 - 26 AWG plastic insulated, solid and stranded copper conductors.
- C. 4-pair connecting blocks shall be utilized to make electrical connection between terminated cables and cross connect wires. The blocks shall be designed to maintain the cable pair twists as closely as possible to the point of mechanical termination.
- D. Base shall employ standoff legs to allow cable routing behind base.
- E. Base shall have integral label holder to identify location of cable.
- F. Horizontal management shall be via jumper troughs furnished with standoff legs.

- G. Vertical cable management shall be via multi pair vertical cable managers designed for use with tower systems.
- H. Provide: TE Connectivity / Krone.

## 2.5. INTERBUILDING FIBER OPTIC CABLE

- A. Provide Corning Indoor/Outdoor Freedom Loose Tube Gel-Free.
- B. Cable shall be suitable for direct burial or duct applications.
- C. Cable shall incorporate a corrugated steel armor tape to provide rodent resistance. Other cable materials shall be all dielectric.
- D. Cable shall be constructed with a dry or gel-filled water-blocking material.
- E. Cable shall be of loose tube construction.
- F. Outer sheath shall be polyethylene (PE).
- G. The outer sheath shall be marked with the manufacture name, words identifying the cable as fiber optic cable, and sequential length markings. The marking shall be in a contrasting color to the cable jacket.
- H. Quantity and type of standards shall be as indicated on the drawings.
- I. Multi-mode optical fibers in each cable shall meet the following specifications:
  - 1. Transmission Windows 850nm, 1300nm, and minEMBc (Laser)
  - 2. Core Diameter 50.0 ± 3µm
  - 3. Maximum Attenuation 3.0 dB/km @ 850nm; 1.0 dB/km @ 1300nm
  - 4. Minimum Bandwidth 3500 MHz/km @ 850nm  
500 MHz/km @ 1300nm  
4700 MHz/km @ minEMBc (Laser)
  - 5. Fiber Classification OM4
- J. Single-mode optical fibers in each cable shall meet the following specifications:
  - 1. Transmission Windows 1310nm, 1383nm and 1550nm
  - 2. Core Diameter 8.3µm
  - 3. Maximum Attenuation 0.5 dB/km @ 1310nm  
0.5 dB/km @ 1383nm  
0.5 dB/km @ 1550nm
  - 4. Fiber Classification OS2

## 2.6. INDOOR/OUTDOOR FIBER OPTIC CABLE

- A. Cable shall be provided wherever it shall run within a wet environment or where it would be exposed to an outdoor condition.

- B. Cable shall be suitable for installation both indoors and outdoors.
- C. Cable shall retain an OFNP plenum rating to meet the listing requirements per NFPA for use within building premises.
- D. Cable shall be loose tube construction.
- E. Cable shall be constructed with a dry or gel-filled type water blocking material.

## **2.7. FIBER OPTIC TERMINATION PANELS**

- A. All fibers shall be terminated on Corning Cable Systems Unicam LC couplings mounted on enclosed patch panels. Couplers shall be mounted on a panel that snaps into the enclosure.
- B. The enclosure shall be designed to accommodate a changing variety of connector types by changing panels on which connector couplings are mounted.
- C. The panel enclosure shall be sized to accommodate the total quantity of fiber strands as described in the specifications and drawings.
- D. Termination panels shall be enclosed assemblies. The enclosures shall incorporate a hinged or retractable front cover designed to protect the connector couplings and fiber optic jumpers.
- E. The patch panel enclosure shall provide for strain relief of incoming cables and shall incorporate radius control mechanisms to limit bending of the fiber to the manufacturers recommended minimums.
- F. Access to the inside of the patch panel enclosure during installation shall be from the front and rear.
- G. The patch panel enclosure shall be configured to require only front access when patching. The enclosure shall provide a physical barrier to access of backbone cables.
- H. The enclosure shall incorporate a storage cassette, tray, or other mechanism designed to allow identification, access and termination of individual fibers.
- I. The fiber optic patch panel shall be rated to match or exceed the ANSI/TIA rated wiring terminated on the panel.
- J. Provide: Corning CCH connector panels and CCH splice cassettes.

## **2.8. FIBER OPTIC CONNECTOR**

- A. The Optical Connector shall be Corning Cable Systems Unicam LC type modular jack. Completed cable assembly shall interface with fiber optic terminal bulkhead feed-through receptacle on Fiber Optic Patch Panel. Supply and install dust caps for terminated fibers.

- B. The connector ferrule shall be ceramic. The optical fiber within the connector ferrule shall be secured with an adhesive [or mechanical connection].
- C. Boot colors shall be Blue for Singlemode and Aqua for Multimode.
- D. Provide:
  - 1. Singlemode: Corning Unicam LC Connectors 95-200-99.
  - 2. Multimode: Corning Unicam LC Connectors 95-05-99-X.

## **2.9. FIBER OPTIC PATCH CORDS**

- A. The fiber optic patch cables shall match the core size and type of fiber being patched. The fiber optic patch cables shall utilize tight buffer construction.
- B. Fiber Optic jumpers shall incorporate connectors that match the terminations of the fiber being patched. Connector body shall be of materials similar to that used in the proposed couplings.
- C. Provide patch cords with connectors compatible with equipment being patched. Verify connector type of active electronic equipment with owner.
- D. Provide one optical fiber patch cord per optical fiber strand installed.
- E. For the TR patch cords, 80 percent shall be 3 meters, 10 percent shall be 4 meters and 10 percent shall be 7 meters in length from the total number.

## **2.10. FIBER OPTIC SPLICE ENCLOSURE**

- A. Splices shall be allowed where required to transition between different fiber optic cable types.
- B. The splice enclosure shall be designed specifically for use in the splicing of fiber optic cables and incorporate splice trays. One splice tray shall be used for each fiber bundle. The enclosure and the splice trays shall be designed to organize adequate slack to allow for re-splicing.
- C. The splice enclosure shall incorporate strain relief for the incoming cables.
- D. Splice enclosure shall be re-usable for system expansion or repair.
- E. Provide: Corning CCH-02H connector housing.

## **2.11. TELEVISION BACKBONE CABLE (RG-11)**

- A. Cable shall be listed NEC Type CATVP quad shielded cable.
- B. Center conductor - 14 AWG solid bare copper; foamed FEP dielectric

- C. Inner shield - aluminum-polyester-aluminum tape with 100% coverage
- D. Second shield - 60% bare aluminum braid wire
- E. Third shield - aluminum-polyester-aluminum tape with 100% coverage
- F. Outer shield - 40% bare aluminum braid wire
- G. Jacket – Kynar Flex
- H. Impedance 75-Ohms'
- I. Velocity of propagation 82%
- J. Nominal attenuation (per 100-feet):
  - 1. at 55-MHz 1.00dB
  - 2. at 700-MHz 4.5dB

**2.12. TELEVISION INDOOR BACKBONE COAX (.500)**

- A. Center conductor - 0.109"
- B. Outer diameter - 0.500"
- C. Impedance 75-Ohms
- D. Velocity of propagation 87%
- E. Maximum attenuation (per 100-feet)
  - 1. at 55-MHz 0.54 dB
  - 2. at 750-MHz 2.16dB

**2.13. TELEVISION OUTDOOR BACKBONE COAX (.500)**

- A. Center conductor - 0.109"
- B. Outer diameter - 0.500"
- C. Impedance 75-Ohms
- D. Velocity of propagation 87%
- E. Maximum attenuation (per 100-feet)
  - 1. at 55-MHz 0.54 dB
  - 2. at 750-MHz 2.16dB
- F. Cable shall employ a water blocking material



#### **2.14. COAX CABLE TAPS, DIRECTIONAL COUPLERS, AND SPLITTERS**

- A. All directional couplers and splitters shall support a video bandwidth of 1 GHz.

#### **2.15. COAX TERMINATION END (F-CONNECTOR)**

- A. F connector shall be male type connector impedance matched to the cable that is terminated.
- B. Connector shall be single piece construction and incorporate a ½" crimp ring with a hex crimp.
- C. Female type F-connectors shall be matched to male connectors.

### **PART 3 - EXECUTION**

#### **3.1. INTERBUILDING COPPER CABLING (VOICE)**

- A. Follow cable manufacturer's cable pulling recommendations. Recommended pulling tensions and pulling bending radii shall not be exceeded. Any cable bent beyond minimum bending radius shall not be installed.
- B. All cable shall be free of tension at both ends. A ten foot service loop shall be provided with each backbone cable.
- C. Avoid abrasion and other damage to cables during installation.
- D. Pulling Lubricant shall be used to ease pulling tensions. Lubricant shall not damage or degrade cable jacket and other materials used. Lubricant shall not harden or become adhesive with age.
- E. Termination of Backbone Voice cabling shall be accomplished by using five-pair clips.
- F. Cables shall be installed in conduit, cable tray, or on J-hooks as shown on the Drawings.
- G. All conductors shall be continuous and splice free.
- H. Bridge taps shall not be allowed.

#### **3.2. VOICE TERMINATION FIELD**

- A. Horizontal wiring troughs shall be positioned at the top of each column of termination blocks and between each 100-pair wiring block.
- B. Vertical cable managers incorporating metal distributing rings shall be provided for vertical routing of jumper and/or cross-connect wire.

- C. Utilize multiple 100 pair tower systems and corresponding vertical cable managers to create termination fields.
- D. Blocks shall identify each pair position by a different color designation. Integral label holders shall allow for easy identification of each location.
- E. The Contractor shall be responsible for the cross connect between the station and backbone cabling.
- F. Cross connect the center two pair of each station cable to the backbone cable. Use single or two pair cross connect wire for this purpose.
- G. Fastening cables directly to support brackets with wire or plastic ties will not be accepted. All cabling shall be neatly laced, dressed and supported. Retainer shall be used on each 110-type block to secure jumper wires on the wiring block(s).
- H. Termination blocks shall have a minimum capacity of 20 percent spare pairs after all horizontal cabling is terminated.

### **3.3. FIBER OPTIC CABLE**

- A. Cable shall be continuous and free of splices except in specified splice trays in TR or ER locations. Factory optical fiber splices are not allowed.
- B. The fiber manufacturer shall subject all fibers to a minimum tensile proof test equivalent to 100-kpsi. All fibers in each cable shall be guaranteed to meet the stated specifications.
- C. Backbone intra-building fiber optic cabling shall be installed via conduit and/or in innerduct in cable tray as illustrated on the drawings.
- D. Provide 15 feet of slack in each backbone fiber optic cable. The cable slack shall be coiled and stored in a location to protect it from damage in the TR or ER in the case of inter-building cables. The slack shall be stored in a separate enclosure designed for this purpose. Multiple cables may share a common enclosure.
- E. Maintain bending radius of twenty times the outside diameter of the cable during installation and ten times the outside diameter with no load.
- F. Backbone Fiber Optic Cable shall be installed in protective innerduct where cable is susceptible to damage. This includes areas cable tray and transitions between pathways. The innerduct should extend into the termination and/or storage enclosure(s) at system endpoints.

### **3.4. FIBER OPTIC CONNECTOR**

- A. The fiber optic connector shall be installed per manufacturer's written instructions.

### **3.5. FIBER OPTIC PATCH PANEL**

- A. Fiber optic patch panels shall be rack mounted.
- B. Install fiber optic patch panels in topmost rack position.
- C. Transition outdoor to indoor cables either by splicing factory-terminated pigtails or by the use of a "fan-out" kit. Secure individual fibers in an aramid reinforced tube.
- D. Termination hardware shall incorporate a mechanism to secure cable and sub-assemblies and prevent damage.
- E. Splicing shall be by the "fusion" method.
- F. Direct termination of 250  $\mu$ m coated fibers shall not be permitted.

### **3.6. FIBER OPTIC PATCH CORDS**

- A. The fiber optic patch cords shall be installed per manufacturer's written instructions.
- B. Contractor must coordinate with the owner for installing all patch cords within the TR.
- C. Any left-over patch cords which are not used for the initial installation shall be placed in a box and handed over to the owner. Patch cords must be new and within the original unopened package.

### **3.7. FIBER OPTIC SPLICE ENCLOSURE**

- A. The fiber optic splice enclosure shall be installed per manufacturer's written instructions.

**END OF SECTION 27 13 00**

## **SECTION 27 15 00 - COMMUNICATIONS HORIZONTAL CABLING**

### **PART 1 - GENERAL**

#### **1.1. SUMMARY**

- A. The work covered under this section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end horizontal structured cabling system throughout the campus and premises. This includes - but is not limited to - furnishing and installing cable, cable supports, cable ties, innerduct and termination components, ancillary equipment, patch cords, testing, labeling and documentation of cables and connectors.
- B. Complete product procurement and installation shall comply with the campus or owner's latest telecommunication and Information Technology standards documents.

### **PART 2 - PRODUCTS**

#### **2.1. MANUFACTURER(S) AND SOLUTIONS**

- A. Acceptable indoor/premise end to end solutions for horizontal copper and components:
  - 1. Belden 10GX REVConnect CAT6A.

#### **2.2. BASIC ENVIRONMENTAL REQUIREMENTS**

- A. Cabling shall be suitable for environment in which they are to be installed.
- B. Cabling shall be plenum rated within interior premise installations.
- C. Cabling shall be outdoor rated within exterior installations subject to outdoor environmental conditions.

#### **2.3. HORIZONTAL STATION CABLE**

- A. Cable shall consist of 4 pair #23 AWG insulated solid copper conductors. Each pair shall be unshielded and twisted.
- B. Transmission characteristics of the cables shall exceed Category 6A performance as defined by industry standards.
- C. The jacket color for station cables shall be Blue.
- D. The jacket color for video surveillance cables shall be Purple.

- E. Provide:
  - 1. Belden 10GXS13D151000 CAT6A Small Diameter cable, UTP, CMP, blue jacket.
  - 2. For video surveillance: Belden 10GXS130071000 CAT6A Small Diameter cable, UTP, CMP, purple jacket.

#### **2.4. HORIZONTAL STATION INDOOR/OUTDOOR CABLE**

- A. Cable shall be provided wherever it shall run within a wet environment or where it would be exposed to an outdoor condition.
- B. Transmission characteristics of the cables shall meet full Category 6A performance as defined by industry standards.
- C. Cable shall be suitable for installation both indoors and outdoors.
- D. Cable shall be suitable for both direct burial and underground conduit installations.
- E. Cable shall retain an OFNP plenum rating to meet the listing requirements per NFPA for use within building premises.
- F. Cable shall be constructed with a dry or gel-filled type water blocking material.

#### **2.5. INDOOR JACKS**

- A. Jacks shall be non-keyed 8-pin 8 conductor (8P8C) modular jacks.
- B. Data termination hardware shall meet full Category 6A performance specifications as defined by industry standards.
- C. Jacks shall be UL verified and listed.
- D. Color of the data jack shall be Blue.
- E. Color of video surveillance jack shall be Purple.
- F. Provide:
  - 1. Data jack – Belden RVAMJKUBL-S1 (or RVAMJKUBL-B24 24-Pack), REVConnect CAT6A UTP Modular Jack, Blue
  - 2. Video surveillance jack – Belden RVAMJKUTP-S1 (or RVAMJKUTP-S24 24-Pack), REVConnect CAT6A UTP Modular Jack, Purple

#### **2.6. OUTDOOR JACKS**

- A. In outdoor conditions as indicated on drawings provide IP67 rated jacks.
- B. Jacks shall be terminated and installed within appropriate outdoor rated stainless steel faceplate as indicated by manufacturer instructions.

- C. Provide weather seals on outlets as needed to equal that of outdoor rated products in the project and per manufacturer's recommendations.
- D. Provide IP67 rated screw on covers produced by the same jack manufacturer for every outdoor jack installed.
- E. Data termination hardware shall meet full Category 6A performance specifications as defined by industry standards.
- F. Jacks shall be UL verified and listed.

## **2.7. TELECOM OUTLET - STANDARD INDOOR**

- A. The combined faceplate and connector jack assembly is referred to as the Information Outlet (IO).
- B. Connector assemblies shall utilize modular jacks as specified in paragraph 2.5.
- C. Outlet faceplates shall incorporate recessed designation strips for identifying labels. Designation strips shall be fitted with clear plastic covers.
- D. The faceplate of the IO shall be constructed of high impact plastic (except where noted otherwise).
- E. Single-gang faceplates shall be 2.75 x 4.5 inches.
- F. Faceplates shall be UL listed.
- G. Color of the wall plate shall be Ivory or White depending on electrical outlet color to match.
- H. Provide:
  - 1. 1-port faceplate: Ivory – AX104565.
  - 2. 2-port faceplate: Ivory – AX104197.
  - 3. 3-port faceplate: Ivory – Part no. to be verified with manufacturer.
  - 4. 4-port faceplate: Ivory – AX104198.
  - 5. 6-port faceplate: Ivory – AX104199.
  - 6. 24 pack dust cover for REVConnect faceplates and outlets, White – RVUDCEW-B24.

## **2.8. TELECOM OUTLET - STANDARD OUTDOOR**

- A. Faceplates shall be IP67 rated faceplate.
- B. Faceplate shall be stainless steel and tamper resistant.
- C. Provide weather seals on faceplate as needed to equal that of outdoor rated products in the project and per manufacturer's recommendations.

- D. The combined faceplate and connector jack assembly is referred to as the Information Outlet (IO).
- E. Connector assemblies shall utilize modular jacks as specified in paragraph 2.6.
- F. Outlet faceplates shall include area for integrating waterproof labels. Designation strips shall be fitted with clear waterproof covers.
- G. Single-gang faceplates shall be 2.75 x 4.5 inches.
- H. Faceplates shall be UL listed.

### **2.9. TELECOM OUTLET - WALL PHONE**

- A. Faceplate shall be stainless steel flush to utilize a single modular jack.
- B. Faceplate shall have standard mounting stubs on top and bottom suitable for wall mounting a standard phone directly over it.
- C. Outlet shall be placed at a location providing 12" x 12" clearance at all sides to accommodate the phone.

### **2.10. TELECOM OUTLET - MODULAR FURNITURE**

- A. Outlet module shall be formulated to fit all jacks in row for use within furniture cabling provision or raceway. Contractor must confirm compatibility of outlet with the raceway manufacturer prior to ordering.
- B. Outlet module shall allow jacks to retain the configuration of the standard information outlets shall accommodate easy to read labels configured horizontally.
- C. Color of the outlet module should be Ivory or White depending on electrical outlet color to match.

### **2.11. TELECOM OUTLET - FLOOR BOX/POKE-THRU**

- A. Faceplate shall include mounting slots for accommodating required jacks within the floor box/poke-thru. Contractor must confirm compatibility of faceplate with the floor box/poke-thru
- B. Faceplate shall be able to fit within standard NEMA provision as well as low voltage floor box and poke-thru provisions.
- C. Color of the faceplate shall be Ivory or White depending on electrical outlet color to match.

### **2.12. TELECOM OUTLET - RACEWAY**

- A. Outlet module shall be formulated to fit all jacks for use within the raceway's provisions. Contractor must confirm compatibility of outlet with the raceway manufacturer.
- B. Outlet module shall allow jacks to retain the configuration of the standard information outlets shall accommodate easy to read labels configured horizontally.
- C. Color of the outlet module should be Ivory or White depending on electrical outlet color to match.

### **2.13. HORIZONTAL STATION CABLE PATCH PANEL**

- A. The data patch panel shall utilize modular jacks as described in paragraph 2.5.
- B. Patch panels shall be 19" wide, flat and rack mounted.
- C. Individual patch panels shall contain a maximum of 24 ports, in 1 RU height.
- D. The data patch panel as a system shall be rated to match or exceed the ANSI/TIA rated wiring terminated on the panel.
- E. Patch panel shall be complete with rear strain relief mechanism for the incoming cables.
- F. The patch panel shall have integral designation strips to identify each port on the front and rear of the panel.
- G. Patch panels shall have a minimum of 20 percent spare ports.
- H. Provide Belden REVConnect solutions:
  - 1. 24-port modular patch panel – Belden RVAPPF1U24BK.
  - 2. Rear Cable Management, rack mountable bar.
  - 3. 24 pack dust cover for REVConnect faceplates and outlets, Black – RVUDCBK-B24.

### **2.14. COMMUNICATIONS INDOOR OUTLET PATCH CORDS**

- A. Patch cords shall be factory manufactured by the same manufacturer providing the horizontal cabling and meet the requirements of Category 6A cabling.
- B. Be round, and consist of eight insulated 23 AWG, stranded copper conductors, arranged in four color-coded twisted pairs within a flame-retardant jacket.
- C. Be equipped with modular 8-position plugs on both ends, wired straight through with standards compliant wiring.
- D. Provide one patch cord per installed jack.
- E. All workstation patch cords shall be 14 feet in length.



- F. For the TR patch cords, 80 percent shall be 7 feet, and 20 percent shall be 14 feet in length from the total number.
- G. Provide:
  - 1. Belden CA21106002 10GX Patch Cord, Bonded-Pair, 4-Pair, 23 AWG Solid, CMR, T568A/B-T568A/B, Blue, 2 ft.

## **2.15. COMMUNICATIONS OUTDOOR OUTLET PATCH CORDS**

- A. In outdoor conditions as indicated on drawings provide IP67 rated patch cords.
- B. Patch cords shall be from the same manufacturer as the outdoor rated jacks submitted for installation.
- C. Patch cords shall be factory manufactured by the same manufacturer providing the horizontal cabling and meet the requirements of Category 6A cabling.
- D. Be round, and consist of eight insulated 23 AWG, stranded copper conductors, arranged in four color-coded twisted pairs within a flame-retardant jacket.
- E. Be equipped with modular 8-position plugs on both ends, wired straight through with standards compliant wiring.
- F. Provide patch cord for all outdoor drops.
- G. Each patch cord shall be 5 feet in length.

## **2.16. WIRELESS ACCESS POINTS**

- A. Contractor shall install owner provided WAP devices and associated mounting accessories:
  - 1. District-provided WAP device will be HPE Aruba AP-515 (US) Unified AP Part # Q9H63A
  - 2. District-provided WAP device mount will be HPE Aruba AP-MNT-E - Network Device Mounting Kit Part # R3J19A
  - 3. District-provided WAP outdoor enclosure will be Oberon 1020-00 13.4 In. Skybar NEMA-4 Plastic Wi-Fi Access Point Enclosure With Opaque Screw-on Cover
- B. Contractor shall document each device location including MAC address, IP address and #SN.
- C. Contractor shall provide and install one 1-2 foot patch cord for each WAP device.

## **2.17. COAX HORIZONTAL CABLE (RG-6)**

- A. Cable shall be listed NEC Type CATVP quad shielded cable.

- B. Center conductor - 18 AWG Copper Covered Steel; 0.040" O.D. (nominal); foamed polyethylene dielectric
- C. Inner shield - aluminum-polypropylene-aluminum laminated tape with overlap bonded to dielectric
- D. Second shield - 60% 34 AWG bare aluminum braid wire
- E. Third shield - non-bonded aluminum foil tape
- F. Outer shield - 42% 34 AWG bare aluminum braid wire
- G. Jacket – Kynar Flex or Flame retardant-PVC
- H. Impedance 75-Ohms
- I. Impedance 75-Ohms
- J. Velocity of propagation 85%
- K. Maximum attenuation (per 100-feet):
  - 1. at 55-MHz: 1.60 dB
  - 2. at 750-MHz: 5.65 Db

#### **2.18. COAX TERMINATION END (F-CONNECTOR)**

- A. F connector shall be male type connector impedance matched to the cable that is terminated.
- B. Connector shall be single piece construction and incorporate a ½" crimp ring with a hex crimp.
- C. Female type F-connectors shall be matched to male connectors.

## **PART 3 - EXECUTION**

### **3.1. HORIZONTAL DATA STATION CABLE AND TERMINATIONS**

- A. All horizontal Data Station Cables shall terminate on modular patch panels in their respective Telecommunications Rooms (TR) or Equipment Room (ER) as specified on the drawings.
- B. The maximum station cable drop length shall not exceed 90-meters. This length shall be measured from the patch panel in the wiring closet to the outlet in the work area. The Contractor is responsible for installing station cabling in a fashion to avoid runs that exceed this distance. Any areas that violate the above constraints shall be identified and reported to the Consultant prior to installation.
- C. All cables shall be continuous and splice-free.
- D. During pulling operation provide adequate resources to observe cable at all points of duct entry and exit.
- E. Avoid abrasion and other damage to cables during installation.
- F. All cable shall be installed free of tension at both ends. In cases where the cable must bear some stress, Kellom grips may be used to spread the strain over a longer length of cable.
- G. Cables shall be supported according to applicable codes. J-hooks used for cable support shall be manufactured solely for the purpose of supporting communication cables.
- H. Supports should be spaced at a maximum 4-foot interval unless limited by building construction. If cable "sag" at mid-span exceeds 12-inches, another support shall be used.
- I. Cable shall never be supported by the ceiling grid.
- J. Cables shall not be attached to existing cabling, plumbing or steam piping, ductwork, ceiling supports or the outside of existing electrical or communications conduit.
- K. Manufacturer's minimum bend radius specifications shall be observed at all times. Cable ties should not be over tightened as to compress the cable jacket. No sharp burrs should remain where excess length of the cable tie has been cut.
- L. Cable sheaths shall be protected from damage by sharp edges. Where a cable passes over a sharp edge, a bushing or grommet shall be used to protect the cable. Bushings shall be used at both ends of all EMT and rigid steel conduit.
- M. Maintain the following minimum separation distances between power and data cables.

Condition	Minimum Separation Distance		
	< 2kVA	2-5 kVA	>5kVA
Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways	5"	12"	24"
Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway	2.5"	6"	12"
Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway		3"	6"
Electrical motors and transformers			48"

- N. Maintain the following minimum separation distances between data cables and specific electromagnetic interference sources:

Source of Disturbance	Minimum Separation
Fluorescent lamps	6"
Neon lamps	6"
Mercury vapour lamps	6"
High-intensity discharge lamps	6"
Arc welders	6"
Frequency induction heating	40"

- O. Cables shall be routed through channel in modular furniture. Communication cabling shall not run in channel with power wiring.
- P. Information Outlets shall be flush mounted on wall-mounted boxes, in floor-mounted boxes, and in modular furniture as shown on Drawings.
- Q. All data and voice cables shall be positioned on termination hardware in sequence of the Outlet I.D. starting with the lowest number.

- R. Termination hardware (Blocks and Patch Panels) positioning and layout must be reviewed by the Consultant prior to construction. The review does not exempt the Contractor from meeting any of the requirements stated in this document.
- S. Patch panels shall be installed to allow for future cables to be added without disrupting existing installation.
- T. Cables shall have a 12" service loop in outlet box or supported properly above ceiling. All WAP cables shall have a 15-20' service loop to facilitate ease in relocating WAP devices based on final wireless survey.

### **3.2. JACKS**

- A. Jacks shall be wired per T-568B pin outs.

### **3.3. INFORMATION OUTLET**

- A. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation.
- B. Outlet boxes shall be secured to building with minimum of two mechanical fasteners per box. Adhesive fasteners are not allowed.
- C. All extra openings to be filled with blank inserts.

### **3.4. COMMUNICATIONS PATCH PANEL**

- A. Panels shall be fully populated with jacks.

### **3.5. HORIZONTAL DATA STATION CABLE PATCH CORDS**

- A. The patch cords shall be installed per manufacturer's written instructions.
- B. Contractor must coordinate with the owner for installing all patch cords within the TR and work area.
- C. Any left-over patch cords which are not used for the initial installation shall be placed in a box and handed over to the owner. Patch cords must be new and within the original unopened package.

### **3.6. TELEVISION COAX AND TERMINATIONS**

- A. RG-6 Coax cable shall be terminated at the workstation and at the TR in a male F-connector.

- B. When preparing the RG-6 cable for termination, manufacturer installation procedures shall be adhered to. Special care shall be taken to insure the proper center conductor length as specified by the manufacturer.
- C. The male F-connectors shall be mated to female/female feed-thru couplings at both the outlet and TR locations. These couplings shall be matched to the male F-connector. Couplings shall be of sufficient length as to allow for the male F-connector to fully seat on both sides.

**END OF SECTION 27 15 00**

## **SECTION 27 51 26 - ASSISTIVE LISTENING SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1. WORK COVERED BY CONTRACT DOCUMENTS**

- A. The work includes the provision of Assistive Listening Systems (ALS) as part of the building project.
- B. Fixed ALS shall be provided to the Owner, where specified.
- C. Portable ALS shall be provided to the Owner, where specified.

#### **1.2. SCOPE OF WORK**

- A. The work shall consist of the design, provision, termination, testing, and documentation of a complete and fully functional ALS. The instructions in this section are specific to the ALS installations and should be read in conjunction with other contract documents as applicable.

#### **1.3. REGULATORY REFERENCES**

- A. ALS equipment provided per this Section shall be in full compliance with the requirements of the 2010 Americans with Disabilities Act and as needed for the facility to meet full compliance.
- B. ALS System shall be provided in accordance with 2019 California Building Code (CBC) Section 11B-219 and shall comply with 2019 CBC Section 11B-706.
- C. The minimum number of receivers to be provided shall be equal to 4% of the total number of seats, but in no case less than two. 25% minimum of the receivers provided, but no less than two, shall be hearing aid compatible in accordance with 2019 CBC Section 11B-706.3.
- D. If the system provided is limited to specific areas or seats, then such areas or seats shall be within a 50-foot viewing distance of, and have a complete view of, the stage or playing area. 2019 CBC Section 11B-219.4.

#### **1.4. PRE-INSTALLATION MEETINGS**

- A. Pre-installation conference: Not applicable

#### **1.5. ACTION SUBMITTALS**

- A. Submit under provisions defined in Division 01 General Requirements.

- B. Prior to ordering materials or commencing any construction activities, the contractor shall provide the Owner with a complete bill of materials, including all quantities of components, devices, equipment, and wiring required to complete this work.
- C. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Manufacturer's installation, operation, maintenance, and cleaning instructions.
- D. Shop Drawings: Indicate fabrication and installation details, electric wiring diagrams, product list including manufacturers, models, and quantities.
- E. Submit proof of qualifications specified in the "Quality Assurance" paragraph

#### **1.6. QUALITY ASSURANCE**

- A. Manufacturer Qualifications:
  - 1. Manufacturer with 10 years minimum successful experience manufacturing Assistive Listening Systems.
  - 2. Manufacturer whose product offerings include all components and accessories needed to execute fully functional ALS systems that satisfy CBC and ADA requirements for each space.

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

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, per Applicable Code Requirements.

#### **1.8. PROJECT CONDITIONS**

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits:

#### **1.9. WARRANTY**

- A. Warranty:
  - 1. Warranty Period: One (1) year from date of Substantial Completion or the manufacturer's stated product warranty, whichever is greater.



## PART 2 - PRODUCTS

### 2.1. MANUFACTURERS

- A. Listen Technologies
- B. Or equal

### 2.2. PRODUCT REQUIREMENTS

- A. Basis of Design
  - 1. Items specified are to establish a standard of quality for design, function, materials, and appearance.
  - 2. Equivalent products by listed manufacturers are acceptable.
- B. Type A – Fixed System
  - 1. The full complement of equipment provided shall constitute a complete system of compatible components as produced by a single manufacturer. A mix of components by multiple manufacturers shall be unacceptable.
  - 2. The assistive listening system (ALS) shall be capable of broadcasting on 57 channels and be frequency agile. The ALS system shall have 80dB SNR or greater, end-to-end. Receivers shall be frequency agile and frequency set with a "seek" button. The receiver will incorporate a stereo headset jack that allows the user to plug in either a mono or stereo headset and listen to audio normally. The portable receivers and transmitters shall incorporate automatic battery charging circuitry for recharging of Ni-MH batteries.
  - 3. Equipment for (1) system for Meeting Room MM101:
    - a. Listen Technologies LT-800-72-01 57-Channel base station (Qty: 1), or equal
    - b. Listen Technologies LR-4200-072 Portable Display receiver (Qty: 2), or equal
    - c. Listen Technologies LA-123 ALS Antenna (Qty: 1), or equal
    - d. Listen Technologies LA-404 Ear Speaker (Qty: 2), or equal
    - e. Listen Technologies LA-430 Neck Loop (Qty: 2), or equal
    - f. Listen Technologies LA-365 NiMH rechargeable batteries. (Qty: 2), or equal
    - g. Listen Technologies LA-381-01 12-Unit Charging/Carrying Case (Qty: 1), or equal
    - h. Cabling to support proper coverage for each system.
- C. Type B – Portable System
  - 1. Portable System – Provide (2) complete systems total, (1) for each East Wing and South Wing

2. The full complement of equipment provided shall constitute a complete system of compatible components as produced by a single manufacturer. A mix of components by multiple manufacturers shall be unacceptable.
3. The assistive listening system (ALS) shall be capable of broadcasting on 57 channels and be frequency agile. The ALS system shall have 80dB SNR or greater, end-to-end. Receivers shall be frequency agile and frequency set with a "seek" button. The receiver will incorporate a stereo headset jack that allows the user to plug in either a mono or stereo headset and listen to audio normally. The portable receivers and transmitters shall incorporate automatic battery charging circuitry for recharging of Ni-MH batteries.
4. Equipment for one (1) complete system:
  - a. Listen Technologies LT-800-216 Portable Transmitter (Qty: 1) and compatible transmitter antennas (Qty: 1), or equal
  - b. Shure MX153B Microflex Headset Microphone (Qty: 1), or equal
  - c. Shure QLXD1 Bodypack Transmitter (Qty: 1), or equal
  - d. Shure QLXD4 Receiver (Qty: 1) and compatible antennas (Qty: 1), or equal
  - e. Shure SB900A lithium-ion rechargeable batteries (Qty: 1 pair) and charger, or equal
  - f. Shure SBC10-100-US battery charger for SB900 rechargeable batteries (Qty: 1), or equal.
  - g. Listen Technologies LR-5200-216 Portable receiver (Qty: 3), or equal
  - h. Listen Technologies LA-430 Neck Loop (Qty: 3), or equal
  - i. Listen Technologies LA-401 Ear Speaker (Qty: 3), or equal
  - j. Listen Technologies LA-365 Li-Ion rechargeable Batteries (Qty: 4 pair), or equal
  - k. Listen Technologies LA-380 12-Unit Portable RF Intelligent Product Charging/Carrying Case (Qty: 1 total to be shared by all portable ALS systems), or equal.
  - l. Listen Technologies LA-304 ALS Notification Signage Kit (Qty: 1 per portable system)
  - m. SKB 4U Roto Shallow Rack Case with Steel Rails, 4-RU (Qty: 1), or equal
  - n. Middle Atlantic D2 drawer (Qty: 1), or equal
  - o. Custom 2-RU black connector plate and connectors to be mounted in rear of Rack Case. Provide custom text engraving on plate and back-fill engraved text with white paint. See Sketch "ALS1" in Appendix A for receptacle and engraved-text information.
  - p. Custom 3' balanced audio adapter cable from the installed AV system's master program audio output to the XLR input on the Custom 2-RU connector plate. Cable may need to be terminated with a 3.5mm on one end and have an XLR-M connector on the other. AVC shall field verify. (Qty: 1), or equal
  - q. All required cabling, connectors, and terminations. See wiring diagram "ALS2" in Appendix A.
  - r. 12' power cable with standard 5-15 plug on one end and a L5-20R twist-lock plug on the other. (Qty: 1), or equal.

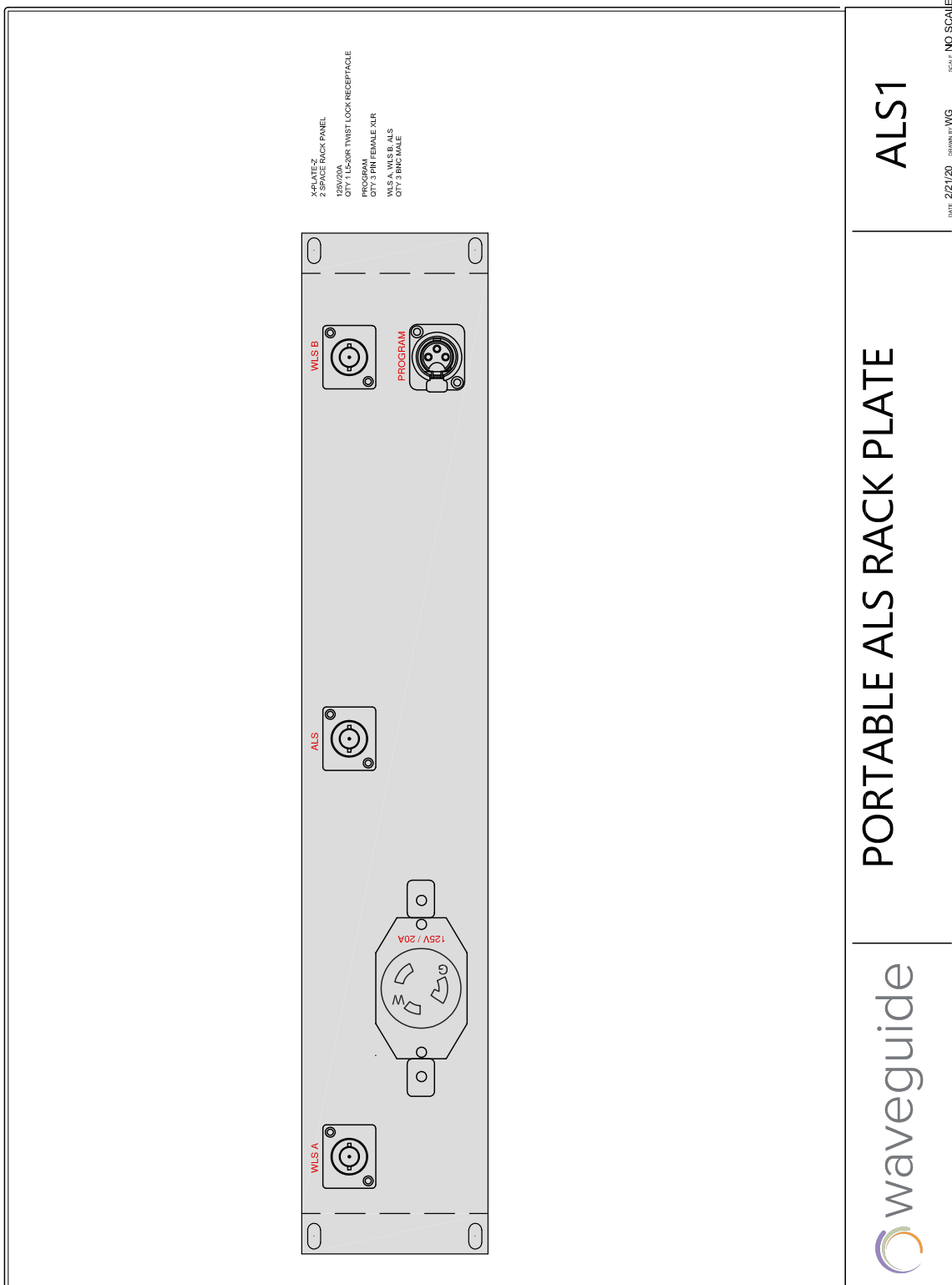
### **PART 3 - EXECUTION**

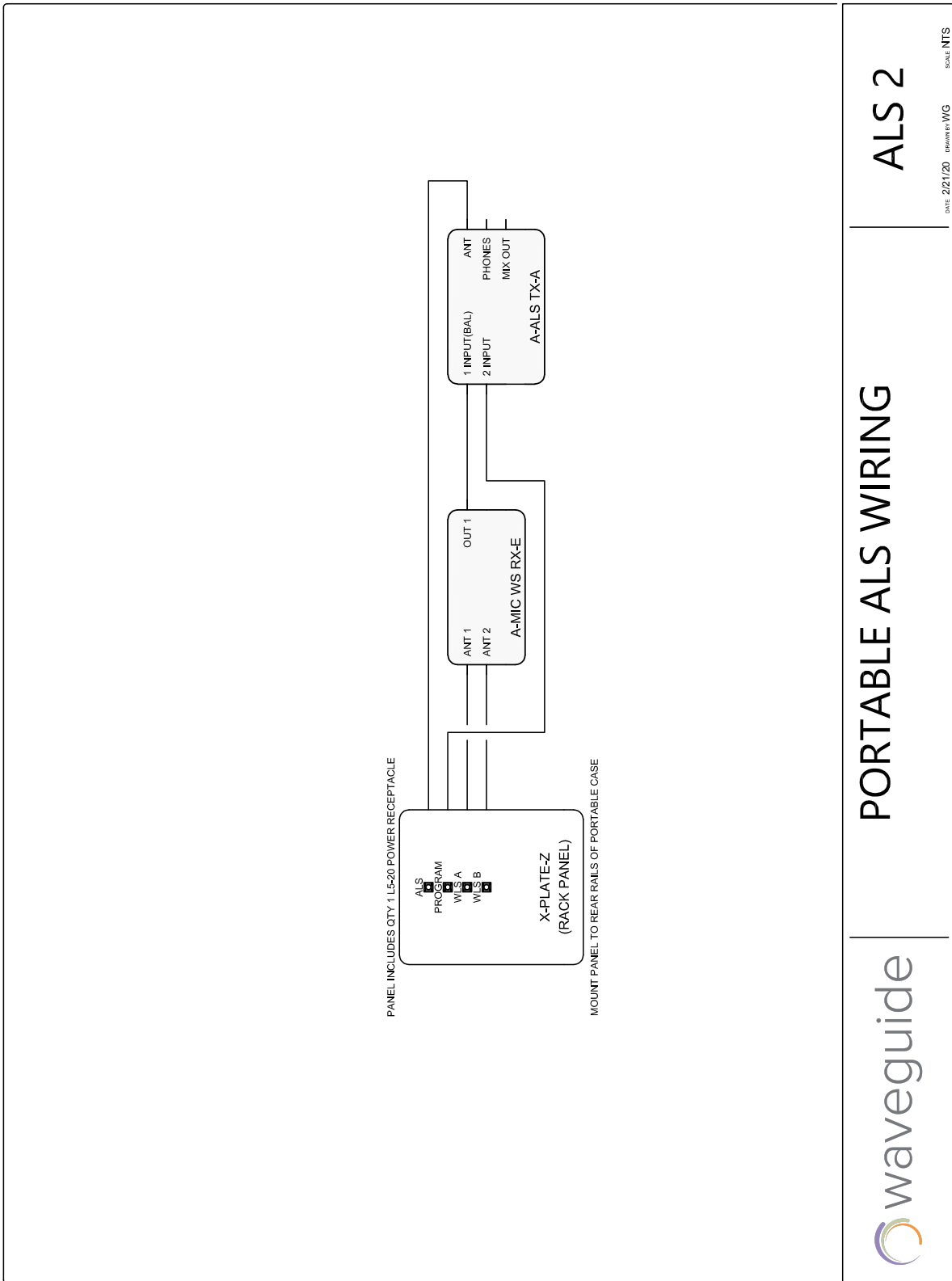
#### **3.1. EQUIPMENT INSTALLATION**

- A. All specified portable ALS equipment shall be delivered to the Owner's Representative unopened in original packaging for installation and/or deployment by others.
- B. All specified fixed ALS system shall be installed in accordance with the Audio Visual systems requirements by the AV integrator

### APPENDIX A – SYSTEM SKETCHES

See below for the ALS system wiring sketches and custom plate requirements.





# PORTABLE ALS WIRING

## ALS 2

DATE: 2/21/20 DRAWN: WG SCALE: NTS

**Waveguide LLC**  
005.2882.000

January 10, 2022  
DSA Back Check

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California

**END OF SECTION 27 51 26**

## SECTION 27 51 27 - EMERGENCY PHONE

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

- A. This Section includes:
  - 1. Emergency phone.
  - 2. Emergency phone tower.

#### 1.02 GENERAL DESCRIPTION

- A. The Emergency Phone (EP) shall consist of an outdoor-rated, vandal resistant and ADA-compliant hands-free speakerphone communications device with a stainless-steel faceplate and metal buttons.
- B. The Emergency Phone shall be Talk-A-Phone model ETP-500C, no substitutions, and have one red anodized aluminum tactile button labeled "EMERGENCY", one black anodized aluminum tactile button labeled "INFO" and one 0.375" diameter red light emitting diode (LED) labeled "LIGHT ON INDICATES CALL RECEIVED". The unit shall be programmable from a remote location and have a two-number dialing capability per button, reverting to the second number if the first is busy or does not respond. The unit shall be totally hands-free on both sides after connection is initiated at site or by attendant. The unit shall be phone line powered, requiring no outside power source or battery back-up. DIP switch programming push to talk devices, and devices requiring external power are not acceptable. The unit shall have a dedicated communication line.

#### 1.03 CONSTRUCTION

- A. Chassis, back box and face plate shall be constructed of stainless steel.
- B. Faceplate shall be 12 gauge #4 brushed stainless steel measuring 9.5" W x 11.75" H.
- C. Wall opening shall measure approximately 6.68" W x 9.75" H x 2.5" D.
- D. Unit shall weigh approximately 8 lbs.
- E. Signage shall be constructed of cast metal with lettering and Braille raised approximately 3/32" for ADA compliance.
- F. Word "EMERGENCY" and top button shall be red, word "INFO" and lower button shall be black.

- G. Each push button and switch shall be a single assembly rated for 1,000,000 cycles.
- H. Speaker and microphone shall be protected by non-ferrous metal screen to provide a barrier against vandalism, rain and snow

#### **1.04 FEATURES**

- A. Unit shall be capable of operating on standard phone lines or analog PBX extensions.
- B. Unit shall dial at approximately 10 tones per second.
- C. Output sound level shall be greater than 80 dB at one meter for normal conversation.
- D. All programming shall be stored in non-volatile EEPROM memory.
- E. Buttons shall provide tactile feedback.
- F. Unit shall be programmable from a remote telephone via keypad entry.
- G. Call timer shall be programmable from 1 to 4320 minutes.
- H. LED for the hearing impaired shall illuminate to indicate when calling party may speak (when receiving party is silent).
- I. Unit shall be programmable with two different telephone numbers of up to 18 digits each including pauses for each button. If first number does not answer or is busy, unit shall automatically call the second number. If that number is busy or does not answer, unit shall call the first number again. Unit shall continue alternating until call is answered or call timer limit is reached.
- J. Unit shall include a line seizure module to allow pressing top button to drop a call initiated by pressing lower button and dial pre-programmed number for top button.
- K. Unit shall include two auxiliary outputs and one auxiliary input that are opto-isolated from the telephone line to 1,000 volts. Outputs shall be activated, providing a dry contact closure, either automatically when Emergency Phone is activated or manually by guard keypad operation. Input shall allow unit to be activated by any device or switch that provides a contact closure. Outputs may be programmed to be activated by either or both buttons.
- L. Incoming and outgoing volume shall be adjustable separately.
- M. Unit shall be capable of automatically notifying attendant of location via Intelli-Voice Identifier. The unit shall transmit Message as soon as call is answered; Message shall be repeatable upon request of operator; Message shall be programmable as 5,10 or 16 seconds; Location identifier message and duration shall be programmable from a remote location. N. Unit shall be capable of silent monitoring.



- N. Unit shall utilize tone dialing.
- O. When call is finished, unit shall automatically shut off.
- P. Unit shall answer any call placed to it from any other telephone.
- Q. Two levels of programmable passwords shall be available.
- R. Unit shall be varistor lightening suppressed and full wave polarity guarded.
- S. Unit shall have parallel tip and ring connected to an RJ-11 connector for quick installation.
- T. Unit shall be compatible with Talk-A-Lert® diagnostics/base-station package, model ETP-TAL.
- U. Unit shall comply with Part 68 of the FCC rules for the United States

#### **1.05 ENVIRONMENTAL**

- A. Speaker: Unit shall have a 3.5 inch waterproof speaker with a vinyl-impregnated cloth cone. Magnet and solid aluminum voice coil area shall be protected from ferrous and non-ferrous particles by a special sealed design. The speaker shall be capable of operating without deterioration of sound quality after total immersion in water for 96 hours. Speaker shall operate at temperatures of -55°C to +85°C. Steel basket shall have a zinc dichromate finish for protection against corrosion.
- B. Microphone: Unit shall include a gold, water-resistant microphone.
- C. Push Button/Switches: Button and switch shall be a single assembly. Epoxy seals shall protect contacts and terminals from hostile environments and solder flux. Unit shall be waterproof and submersible to 3 feet in water. Unit shall have a mechanical life of 1,000,000 cycles. Case shall be moisture-proof, dust-tight and designed to accommodate the high shock military specifications of MIL-STD-202, method 207. Case shall be aluminum alloy, anodized clear. Button shall be red anodized aluminum. Switch shall be rated to operate from -55°C to +80°C.
- D. PC boards and Other Electronic Components: Boards and components shall withstand a corrosive atmosphere of 90% H<sub>2</sub>S for 16 hours. PC boards shall be rated R4. Unit shall be designed to operate at temperatures from -20°C to +65°C and humidity levels up to 95% relative humidity at 49°C.
- E. Protective Sealing of Completed PC Boards: Once the unit has been wave soldered and inspected and the completed boards tested, the entire circuit board apparatus shall be conformally coated by dipping rather than spraying (Mil-I416058C amend 6). The microprocessor chip shall then be installed in its socket and sealed in place with a special electrical grade RTV type sealant. At this point the boards can be sprayed with water without affecting the operation of the unit

**1.06 ELECTRICAL**

- A. Unit shall be fully phone line powered, requiring no external power or battery back-up.
- B. One dedicated, twisted-shielded communication pair shall provide a minimum of 24VDC and 20mA while off hook

**1.07 MOUNTING**

- A. Unit shall include six vandal-resistant, truss-head spanner mounting screws to mount flush into any of the following mounts:
  - 1. Steel Tower Mounts shall be available with 0.25" thick walls, integrated 1.5 million candle power blue light strobe and lighted faceplate. When the Emergency Phone is not in use, the blue light shall remain lit and visible from a distance. The faceplate shall also remain lit. When the EMERGENCY button is pressed, the strobe shall flash brightly and continue to flash for the duration of the communication. Tower mounts shall be available with optional integrated fixed CCTV.
    - a. Tower Mount, model ETP-MT, measures 114" H x 10" W x 8" D.

**1.08 COMPLIANCE**

- A. CSA Certified to UL Standard 60950

**1.09 WARRANTY**

- A. Equipment shall be warranted against any defects in material and workmanship, under normal use, for a period of twelve months from date of installation. In the event system is found by manufacturer to be defective within the warranty period, manufacturer shall repair and/or replace any defective parts, provided the equipment is returned to manufacturer

**1.10 QUALITY ASSURANCE**

- A. The Manufacturer shall be Talk-A-Phone Co. (773) 539-1100, 7530 N. Natchez Ave, Niles, Illinois 60714, www.talkaphone.com. THERE ARE NO EQUIVALENTS
- B. Installer Qualifications: Authorized and trained by the manufacturer to install systems required.

**1.11 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until ready for installation.

- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction

## 1.12 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. The Manufacturer shall be Talk-A-Phone Co. (773) 539-1100, 7530 N. Natchez Ave, Niles, Illinois 60714, www.talkaphone.com. THERE ARE NO EQUIVALENTS

### 2.02 MOUNTING

- A. The phone shall be coordinated with Electrical contractor and shall meet all manufacturer installation and testing requirements.
- B. There is no scope for EP internal to facility CT2. EP on this project shall be located exterior to CT2. Location as shown per Telecom site plan, and shall be coordinated through the Construction Manager prior to any rough-in work.
- C. Provide attachment hardware, fasteners, and other components of type, size, and spacing recommended by manufacturer for complete, functional, secure installation of EP.

### 2.03 COMPONENTS

- A. All electrical components shall have quick-disconnect terminals for easy service or removal. All wiring shall be concealed within the bollard and shall not be visible from the outside of the unit.
- B. The unit shall require 120 VAC and draw a maximum of 3 amperes under normal operation. The entire unit shall be surge protected.
- C. The speakerphone shall require 20 mA loop current at the unit. A 22 to 26 AWG shielded twisted pair cable shall be used. Longer cable runs shall require the heavier gauge cable

## 2.04 STROBE LIGHTS

- A. Strobe light shall be located at the top of the unit. The strobe light shall generate approximately 1,000,000 candlepower and have a flash rate of no less than 60 flashes per minute. A deep blue polycarbonate prismatic refractor that distributes the light in a horizontal pattern, making the flash bright and visible even at great distances shall cover the strobe.
1. The strobe light shall be automatically activated when the “PUSH FOR HELP” button on the communications device is touched and shall continue to flash until the answering party deactivates the unit. The strobe cannot be turned off at the unit itself.
  2. Area light/beacon – A high intensity discharge (HID) 70-watt, high-pressure sodium area light shall be located under a reflective disk that is situated within the bollard near the top of the unit. The area light shall be centered between the lenses and shall be partially surrounded by a heavy-gauge, deep blue, translucent, prismatic refractor made of Lexan type polycarbonate.
  3. Reflectors shall direct the light of the lamp outward and downward from the unit. This shall create a pool of light around the unit, making persons standing near the unit visible to passersby and/or to a responding officer. The area light shall always be illuminated.
  4. Faceplate light – A long life, LED light fixture shall be concealed within the unit above and directly forward of the communications device. This fixture will direct light onto the communications device faceplate, and shall be vandal resistant
- B. COMMUNICATIONS
1. The unit shall have a high quality, vandal resistant and ADA compliant speakerphone communications device.
  2. The speakerphone shall be Talk-A-Phone Co. and have one 1.5-inch piezoelectric button labeled “PUSH FOR HELP,” one 3/8 inch diameter red light emitting diode (LED) labeled “Call Placed,” and one 3/8 inch diameter green LED labeled “Call Received.” The speakerphone shall have an internally mounted electronics enclosure, auxiliary power, and shall be capable of playing up to two digitally stored voice messages upon activation. The electronics enclosure shall be capable of using interchangeable faceplates: a single-button faceplate, a two-button faceplate, or a two-button faceplate with keypad. The speakerphone shall be programmable from a remote location and have a three-number dialing capability per button. Battery backup shall be rated for 16 hours of active talk time and 32 hours of standby. Line powered phone devices, DIP switch programming, and push-to-talk devices are not acceptable

## 2.05 FINISH

- A. The unit shall be finished with a coating process known to be highly graffiti resistant.
- B. Substrate preparation shall be as required to comply with applicable ASTM impact and adhesion standards.
1. D2794 - Direct and Reverse Impact
  2. D523 - Gloss @ 60 degrees
  3. D3359B - Cross Hatch Adhesion
  4. B117 - Salt Spray Resistance

- C. The polyurethane finish shall be a multicoat system available in 10 standard colors and custom colors as specified by the user and approved by the manufacturer.
- D. The primer coat and finish coat shall each have a minimum coverage thickness of 2.0 mils.
- E. Other types of protective finishes are not acceptable

## **2.06 GRAPHICS**

- A. The graphics shall be matching all LBCC standard for Talk-A-Phone Co. Emergency Telephone stations.
- B. The graphics shall be a durable engineering grade reflective vinyl for high visibility and legibility.
- C. The standard graphics text shall be “Emergency,” “Assistance,” “Security,” or “Courtesy” and shall be available in 30 inch lengths. Standard colors shall be “reflective white,” “reflective blue,” and “reflective black.”

## **2.07 OPTIONS**

- A. Not all options listed below are required at this time for LBCC Campus deployment and are required to be reviewed with the Construction Manager prior to equipment ordering and rough-in
- B. The unit shall be capable of communicating through a full duplex radio frequency (RF) communications system operating within the 2.4-2.485 frequency band (license free). It shall be capable of transmitting calls by means of radio frequency and then routing them into a PBX or central office line. Push-to-talk interfaces are not acceptable. Radio frequencies of 400 and 800900 MHz are not acceptable due to frequency interference from other communications devices. Refer to the RF specification for further details.
- C. The unit shall be capable of cellular communications instead of a hard-wire phone line. Refer to the cellular specification for further details.
- D. A solar powered ventilation fan (active) shall be available for applications where high humidity is prevalent (not required at this time for LBCC Campus deployment).
- E. There shall be an option of customized paint colors and graphics. Colors other than standard shall be available based on RAL number specified by the user and approved by the manufacturer.
- F. The unit shall be capable of accepting an integrated overhead camera mount that accepts a 1½ NPT dome camera supplied by others. The overhead camera mount shall be designed to be available and ordered with the CB I unit or as a retrofit to installed CB I units.

**2.08 WARRANTY**

- A. The unit shall be warranted for a period of two years. Reference manufacturer's warranty for further details.

**2.09 MANUFACTURER**

- A. The Manufacturer shall be Talk-A-Phone Co. (773) 539-1100, 7530 N. Natchez Ave, Niles, Illinois 60714, www.talkaphone.com. THERE ARE NO EQUIVALENTS
- B. Talk-A-Phone Co. manufactures its products according to the most recent revision of product specifications and shall not be held responsible for obsolete or outdated specifications. For the latest revision, please refer to manufacturer's web site.
- C. s and have one 1.5-inch piezoelectric button labeled "PUSH FOR HELP," one 3/8 inch diameter red light emitting diode (LED) labeled "Call Placed," and one 3/8 inch diameter green LED labeled "Call Received." The speakerphone shall have an internally mounted electronics enclosure, auxiliary power, and shall be capable of playing up to two digitally stored voice messages upon activation. The electronics enclosure shall be capable of using interchangeable faceplates: a single-button faceplate, a two-button faceplate, or a two-button faceplate with keypad. The speakerphone shall be programmable from a remote location and have a three number dialing capability per button. Battery backup shall be rated for 16 hours of active talk time and 32 hours of standby. Line powered phone devices, DIP switch programming, and push-to-talk devices are not acceptable.
- D. The CB3100 speakerphone shall have the following standard features:
1. Three number dialing capability up to 16 digits per button.
  2. Remotely programmable.
  3. Remote electronics mounting
  4. (extendable up to 5' with optional 3' ribbon extension).
  5. Three reporting inputs (aux one input has optional activation).
  6. Two output relays (optional aux 2 salvable to aux 1).
  7. Remote control speaker volume adjustment.
  8. Silent monitoring mode, password protected.
  9. Remote control two step microphone sensitivity adjustment.
  10. Programmable passwords.
  11. Programmable conversation time.
  12. Allows the black button on a keypad phone to act simply as a hook switch or as a speed dial button before allowing keypad use (for auto dialing into automated systems).
  13. Detects inaudible hang-up commands from the phone system to allow the CB3100 to detect more accurately when the operator has disconnected from the call.
  14. Allows for the lockout of "during call commands."
  15. Internal watchdog timer to detect and restart the micro controller after a lock up.
  16. Supports the RPD diagnostic routine that tests the integrity of the microphone and speaker when used with the FP series faceplates
  17. RS485 data jack to allow a RS485 device to activate the phone.

18. Programming option to set the number of times voice message(s) are played.
19. Capable of using interchangeable faceplate single button, dual button and dual button with keypad.
20. Re-playable message(s) on demand.
21. Output sound level >80 dB at 1 meter for normal conversation.
22. Waterproof 3.5-inch speaker.
23. Waterproof microphone.
24. Operating temperatures of -40°F to +150°F (-40° to +65°C).
25. Conformal coated speakerphone electronics to withstand harsh environments.
26. Capable of playing messages simultaneously at the unit and to the call center.
27. EEPROM Memory ensures that programming is retained during power loss.
28. Capable of notification when AC power has been off for 15 minutes.
29. Auxiliary power supply, battery back up – 16 hours active talk time, 32 hours standby time.
30. Highly flexible two stored voice identifiers – includes four modes of operation.
31. Easily integrate with CCTV, alarm systems and other security equipment.
32. Compatible with 4+1 Express and 4+2 Express Formats.
33. Optional AMPS cellular transceiver.
34. Optional 2.4 GHz transceiver.
35. Complies with FCC Part 15 and TIA/EIA/IS968

## **PART 3 - EXECUTION**

### **3.01 CONSTRUCTION**

- A. Tamper resistant fasteners manufactured by the Talk-A-Phone Co. shall be used. It shall not be possible to enter the unit or remove any component without a special computer designed bit-wrench designed for this purpose. These bit-wrenches are supplied only by the manufacturer of the unit. All other types of fasteners shall not be acceptable due to the abundance of nonproprietary tools available for their removal.

- 3.02 The opening shall have a cover plate flush with the unit, whose wall thickness and radius shall be the same as the bollard. The cover plate shall fit precisely into the opening, have a weather resistant gasket to prevent water from entering the unit, and shall be held in place by two 1/4-20 by 1 inch countersunk, tamper resistant, proprietary fasteners as supplied by the manufacturer

### **3.03 MOUNTING**

- A. The emergency phone shall be coordinated with electrical contractor and shall meet all manufacturer installation and testing requirements
- B. There are no internal building EP sets for facility CT2 Project. EP on this project shall be located exterior to facility CT2 approximate location as shown per Telecom Site Plan. The placement of the EP shall be coordinated through the Construction Manager prior to any rough-in work.

**3.04 COMPONENTS**

- A. All electrical components shall have quick-disconnect terminals for easy service or removal. All wiring shall be concealed within the bollard and shall not be visible from the outside of the unit.
- B. The unit shall require 120 VAC and draw a maximum of 3 amperes under normal operation. The entire unit shall be surge protected. This item shall be coordinated with electrical contractor through the Construction Manager.
- C. The speakerphone shall require 20 mA loop current at the unit. A 22 to 26 AWG shielded twisted pair cable shall be used. Longer cable runs shall require the heavier gauge cable

**3.05 MANUFACTURER REQUIREMENTS**

- A. The Contractor's installer(s) shall be Talk-A-Phone Corporation trained. The contractor's installer(s) shall have installed a minimum of (qty. 3) Talk-A-Phone Co. instruments or shall be supervised by a manufacturer's representative that will sign-off on the installation's correctness.
- B. Talk-A-Phone Co. manufacturer's installation manual shall be provided to the Construction Manager and all installation shall be adhered to for each Talk-A-Phone Co. Station set installed

**END OF SECTION 27 51 27**



**SECTION 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specifications, apply to this Section.

**1.2 SUMMARY**

- A. Part 1 Includes:
  - 1. Related Documents
  - 2. Summary and related sections
  - 3. References
  - 4. Definitions
  - 5. System Description and General Responsibilities
  - 6. Coordination
  - 7. Quality Assurance
  - 8. Submittals
  - 9. Delivery, Storage, and Handling
  - 10. Site Conditions
  - 11. Sequencing and Scheduling
  - 12. Warranty
  - 13. Extra Materials
- B. Part 2 Includes:
  - 1. Product Options and Substitutions
  - 2. Materials and Equipment
  - 3. Equipment Modification
  - 4. Fabrication
  - 5. Source Quality Control
  - 6. Firestopping/Sealant Materials
- C. Part 3 Includes:
  - 1. Examination
  - 2. Installation
  - 3. Field Quality Control
  - 4. Cleaning
  - 5. Training
- D. Related Sections:

- |    |          |                                |
|----|----------|--------------------------------|
| 1. | 28 13 00 | Physical Access Control System |
| 2. | 28 16 00 | Intrusion Detection System     |
| 3. | 28 23 00 | Video Surveillance System      |
| 4. | 28 26 00 | Duress Alarm System            |
| 5. | 28 31 00 | Fire Alarm Systems             |

### **1.3 REFERENCES**

Codes compliance - Comply with the established project edition of the following codes as applicable:

- |    |  |      |
|----|--|------|
| 1. | National Fire Alarm Codes (NFPA 72)                      | NFAC |
| 2. | All Local, State, County or Federal codes and ordinances |      |

B. Standards Compliance - Comply with the following standards as applicable:

- |     |   |      |
|-----|---|------|
| 1.  | American National Standards Institute         | ANSI |
| 2.  | American Society for Testing and Materials    | ASTM |
| 3.  | Electronics Industry Association              | EIA  |
| 4.  | Electrical Testing Laboratories               | ETL  |
| 5.  | Federal Communications Commission             | FCC  |
| 6.  | Institute of Elect. and Electronics Engineers | IEEE |
| 7.  | National Electrical Contractors Association   | NECA |
| 8.  | National Electrical Manufacturers Association | NEMA |
| 9.  | National Fire Protection Association          | NFPA |
| 10. | Occupational Safety Health Act                | OSHA |
| 11. | Underwriter's Laboratories                    | UL   |

### **1.4 DEFINITIONS**

- A. By Others or By Other Trades: By persons or parties other than the Division 28 Contractor. In this context the words "by others or by other trades" shall not be interpreted to mean "not in contract (NIC)".
- B. Certified: Equipment has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards and found to be safe for use in a specified manner; production is periodically inspected by a nationally recognized testing laboratory; and it bears a label, tag, or other record of certification.
- C. Concealed: Not visible or readily accessible such as, embedded in masonry or other construction installed behind wall furring with double partitions or above hung ceilings, in crawl spaces, in shafts.
- D. Conveniently Accessible: Capable of being serviced without climbing or crawling under or over obstacles, and with adequate working clearance both front and back.
- E. Damage: Visible or invisible abuse that negatively affects performance or appearance and creates defective materials or workmanship.

- F. Defective Materials or Workmanship: Operational failures, performance below minimum requirements, evidence that the system will not be reasonably maintainable, errors in documentation, abnormal operations, unsafe conditions, or similar unsatisfactory performance.
- G. Contractor: Company holding the contract or agreement with the Owner or its representative. The Contractor may, when permitted, sub-contract Work described in this Section to which the term contractor may apply.
- H. Exposed: Not concealed.
- I. Failure: Any deviation from intended system operation and performance, as determined by the Contract Documents and subsequent submittals and the Owner's Representative.
- J. Furnish: Purchase and deliver to the Project site complete with every necessary appurtenance, support, and accessory required for operation.
- K. Install: Unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the Project.
- L. Labeled: Equipment embodies a valid label, symbol, or other identifying maker of a nationally recognized testing laboratory such as Underwriters' Laboratories, Inc., the laboratory makes periodic inspections of the production of such equipment, and the labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.
- M. Listed: Equipment is mentioned in a list which is published by a nationally recognized laboratory which makes periodic inspection of the production of such equipment or states that such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner.
- N. Nationally Recognized Testing Laboratory: A testing laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.
- O. Provide: Furnish and install, completely ready for use, including all accessories required for operation.

## **1.5 SYSTEM DESCRIPTION AND GENERAL RESPONSIBILITIES**

- A. The work to be performed under this contract includes the furnishing of all labor, materials, and equipment for a video surveillance system, a physical access control system, a duress / panic system, and an audio announcement system. Work shall include all provisions of new electronics controls systems, including, physical access control, duress alarm, video surveillance, and audio. Portion of the work are to be bid as an optional add alternate, and the Owner may or may not choose to execute this work under the contract.
- B. Combined Prescriptive and Performance Design Requirements
  - 1. Division 28 includes a combination of prescriptive and performance specifications. Compliance with the performance specifications, as well as coordination and integration

of the prescription requirements, will require substantial design work on the part of the Contractor.

2. The performance requirements are intended to establish overall system performance requirements, satisfy the operational requirements, and establish the inter-coordination requirements for the Division 28 systems.
3. The prescriptive requirements establish the minimum quality, characteristics, and types of components, equipment, and materials to be used to achieve the stated system performance requirements. The Contractor is advised, however, that prescriptive specifications have not been provided to satisfy all of the specified performance requirements.
4. The Contractor shall carefully consider all of the requirements for each of the Division 28 systems when preparing its bid. Any questions regarding the intent of these requirements, the scope of the systems or their coordination requirements must be submitted in writing prior to bidding in accordance with the Instructions to Bidders. The Contractor shall have no claim for either extra compensation or extra time on the grounds that it did not understand the scope or the requirements of the Division 28 work, and/or the coordination requirements of the Division 28 work with the work of the other Divisions.
5. Compliance with the project requirements will be progressively monitored and adjusted through the submittal process, installation period, and performance verification testing.

C. Drawing Interpretation

1. The Drawings are diagrammatic and indicate the general arrangement of systems and equipment unless indicated otherwise by dimensions or detail drawings. The Drawings installation and schematic diagrams and symbols to outline the Work to be provided. These drawings do not have any dimensional significance nor do they delineate every item required for the intended Work. No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete Work are excluded.
2. The Work shall be provided in accordance with the intent expressed on the Drawings and Specifications, and in conformance with the actual building architectural and structural conditions. When in conflict, field conditions take precedence over the Contract Documents.
3. The meaning of abbreviations shall be the same whether in lower case letters or without periods.
4. The use of words in the singular shall not be considered as singular where other indications denote that more than one item is referred to.
5. Details that appear on the Contract Documents which are specific with regard to the dimensioning and positioning of the Work, are intended only for the purpose of establishing general feasibility. They do not replace engineering or field coordination by the contractor for the Work.

D. Provide all parts and equipment for a complete and operational system for the Work of Division 28 as described herein and shown on the drawings.

E. Furnish and install all trenching and backfill, duct banks, conduits, raceways, sleeves, boxes, gutters, shelves, enclosures, shelf and enclosure supports, backboards, pull ropes (in unused or spare conduits) required to make all systems fully operational, including components not shown on the Drawings, but necessary for fully operational systems.

- F. Furnish, install, terminate, test, dress, and identify all wire and cable required to make systems fully operational, including all wire and cabling not shown on the Drawings, but necessary for fully operational systems.
- G. Recognize that the Work entails integration between individual systems, as well as the design and implementation of many system and component interfaces. Take full responsibility for the complete design, installation, and performance of the total integrated system, including integration between systems and various interfaces, in order to achieve the specified operational features and system performance requirements.
- H. Fully test the systems, demonstrate their satisfactory operation, and train maintenance and operating personnel, as specified in this Section and the Sections governed by this Section.

## **1.6 COORDINATION**

- A. Coordinate with the Owner and all other trades as required to ensure that the entire Work of this Project will be carried out in an orderly, complete, and coordinated fashion.
- B. Coordinate installation of lighting and ventilation in all equipment rooms and control stations to avoid any possible interference and to enhance system function.
- C. Coordinate with the Work of all applicable Divisions and Drawings for the required electrical and mechanical control interfaces to the work of this section.
- D. If applicable, provide coordination drawings of security device plate mounting templates and internal frame conduits to the hollow metal frame manufacturer/supplier to facilitate frame preparation for electronic devices. Rework all frames for which device mounting has not been coordinated at Contractor's expenses.
- E. If applicable, obtain product data and wiring schematic information from the Division 8 and 11 Contractors/manufacturers for all approved locking and door monitoring hardware. Coordinate with the Contractors to properly wire, terminate and test all electrically controlled and monitored door/gate hardware.

## **1.7 QUALITY ASSURANCE**

- A. Division 28 requires contractors with similar work experience and specific licenses and certifications to perform the work of this section. Contractors must be certified or licensed at the time of bid where Manufacture certification or licensure is required. Required licenses and certifications shall be submitted the contractor's bid package.
- B. The Division 28 contractor shall have had experience in the design and installation of similar systems of similar project sizes and similar integration as this project to be considered qualified.
- C. The Contractor shall be responsible for all costs incurred including costs incurred by the Owner and its representatives for failure to provide the experience and key personnel as specified.

1. Deductive change orders may be issued as a result of the failure to properly engineer the work prior to construction or improperly installed work that results in costs incurred to the Owner. Examples of incurred costs are rejection of submittals for failure to follow specifications or failure to properly engineer the work; re-inspection of rejected work.
- D. The Division 28 contractor shall maintain a local service center with qualified service technicians for the duration of the Warranty.
- E. The Division 28 Contractor shall have an active C-7 or C-10 contractor's license, as required by the project scope, issued by the State of California.
- F. Key Project Personnel must have work experience with projects of similar size and complexity. Systems experience shall be demonstrated for the Key Project Personnel. Résumés of prospective key personal shall be submitted within 30 days of contract award.
  1. Project Manager Qualifications
    - a. Five years' experience with projects of similar size and complexity.
  2. The approved Project Manager shall represent the Contractor at all times in all project matters and shall be responsible for the administrative work including but not limited to, the following:
    - a. Representation at all project meetings.
    - b. Progress schedule and progress reporting.
    - c. Payment schedule of values and pay requests.
    - d. Representation and management of all employees and sub-contractors.
    - e. Conduction of on-site performance and acceptance testing.
  3. The approved Project Engineer shall be qualified and shall be responsible for technical work including but not limited to, the following:
    - a. Preparation and signature of all engineering, shop drawings, and product data submittals.
    - b. System fabrication, field installation work, and testing.
  4. Consider all qualification and experience materials submitted as binding. Obtain the Owner's approval in writing prior to any deviations from the minimum requirements in organization, personnel, work plan, quality control plan, procurement plan or other declaration within the qualification submittal. Key project personnel substituted prior to or during the Work must meet the specification requirements and obtain the Owner's approval.
- G. Regulatory Requirements and Standards:
  1. Obtain and pay for all permits and inspections required by all legal authorities and agencies having jurisdiction for the Work. The certificates of all such permits and inspections shall be delivered to the Owner.

## **1.8 SUBMITTALS**

- A. Submit under provisions of Division 1, Submittals.
- B. Contractor is advised that approval or acceptance of product data or shop drawing submittals does not release the contractor from providing all necessary documentation per submittal requirements, nor does it obviate contractor from additional design and coordination throughout the project.
- C. Work Plan
  - 1. Submit a work plan for all work to be performed in the existing facility within 15 days of the Notice to Proceed.
- D. CPM Schedule
  - 1. Submit a Critical Path Method Schedule within 30 days of the Notice to Proceed.
  - 2. At a minimum show tasks by area such as by building, by floor or other appropriate designations.
  - 3. Include tasks that are not part of the work of this section but that may affect this section such as work by other trades or contractors or Owner review time.
  - 4. Include tasks that are not part of the work of this section but that may affect this section such as work by other trades or contractors or Owner review time.
- E. Submittal Matrix
  - 1. Prepare a matrix of submittals by type vs. section of all submittals to be made by the Division 28 contractor within 30 days of the Notice to Proceed.
  - 2. Utilize the list of required submittals listed at the end of this section as a starting point. Add columns for expected delivery dates and each specification section. If a listed submittal is not required for a specific section, indicate such with an "N/A" or other means in the column and row cross point.
- F. Schedule of Values
  - 1. Submit a Schedule of Values (SOV) based on the CPM schedule and Submittal Matrix that reflect the value of the systems and installation of work for this Division.
  - 2. That approved SOV will be used as a basis for progress payments.
- G. Product Data:
  - 1. Product data is required for all materials and equipment. Include complete bill of materials for each section with the product data submittal.
  - 2. Cross-reference submitted items to the Specifications using their related sections and paragraph numbers.
  - 3. Submit complete product data for the all system components in a single, bound submittal of one or more volumes. Provide a table of contents and labeled divider tabs for each section. Partial submittals for individual sections will be returned without review.
  - 4. Include descriptive literature, catalog cuts, illustrations, schematics, technical data sheets, and test data necessary for the Owner's Representative to ascertain that proposed equipment and materials comply with specification requirements. Include manufacturer's

name, model, catalog or part numbers. Catalog cuts shall be legible and shall clearly identify equipment being submitted.

5. Include required calculations, I/O points lists, system zone schedules, and other tabular data as necessary to clarify system sizing and configuration. Do not, however, consider such submittals as a substitute for complete shop drawings.
6. Disclosure of Product Deviations: Specifically identify and tabulate any and all deviations from the contract documents including all system functions and features. Reference the corresponding specification sections and paragraph/article numbers. All variances and deviations will be reviewed for acceptance or rejection. It will be the Contractor's sole responsibilities to comply with all other contract requirements not revealed in the disclosure of product deviations.

H. Shop Drawings:

1. Shop drawings are required for all systems and component assemblies.
2. AutoCAD “.dwg” files of the Contract Drawings may be made available upon request. These files may be used as a first step in the preparation of shop drawings. Do not consider the drawing plots from such files as a substitute for the shop drawings that are to be prepared by the contractor.
3. Shop drawings will not be accepted or considered unless they are submitted as a complete package for each specification section. Partial submittals covering less than a whole system or with incomplete interfaces to other systems will be rejected.
4. Standard manufacturer's drawings may not be used as shop drawings unless specifically modified for use on this project.
5. Each drawing requires a unique drawing number and revision level. Revisions shall be dated and referenced per submittal number. Delta numbers and clouds on the drawings shall be used in all instances where changes have been made to the previous submittal.
6. At a minimum, include the following shop drawings:
  - a. Floor Plans: Scaled drawings showing equipment and device locations in plan view. Include wire and cable types and quantities, raceway sizing and routing. Routing information shall indicate where rated assemblies are penetrated. Separate into as many plan series as needed to prevent overlapping information. These drawings shall be fully coordinated with other trades prior to submittal. Show relationships to adjacent surrounding structures.
  - b. Equipment and Control Room Plans and Elevations: Scaled, dimensioned drawings showing security equipment layouts in security equipment rooms, electrical/security closets, and control rooms. Include electrical J-boxes and receptacles, power, conduit sizing and routing, metal gutters, wiring ducts, cable trays, and supports. Indicate all other non-security cabinets, enclosures, and equipment within the room. All constraints and clearance requirements shall be shown in dimensioned drawings.
  - c. Cabinet, Enclosure, and Rack Elevations: Scaled, dimensioned drawings for each system equipment cabinet, enclosure, and rack showing component and equipment mounting, wire and cable routing and separation, connector and terminal block locations and labeling, and all necessary fabrication details.
  - d. System Block Diagrams: Single line block diagrams showing the general relationship between system components and the interconnection between systems. Use these drawings as a reference for the Single line diagrams and point-to-point diagrams by cross-referencing the shop drawing number of those diagrams on these drawings.



- e. Single Line Diagrams: Interconnection diagrams for the riser and trunk wiring between equipment cabinets, enclosures racks and major components. Use the same equipment designations as the floor plans and block diagrams.
  - f. Point-to-Point Diagrams: Drawings which show the wiring of each component or device of each individual system. Include details of power supply, grounding, shielding, shield grounding, surge protection, fusing, connector pin-outs, terminal assignments, and similar wiring and connection details. Use the same component and device designations as the floor plans and other shop drawings.
  - g. Device Installation Diagrams: Details which show the installation and wiring termination of each field device in each individual system. Include settings for dipswitches, jumpers, addresses, port assignments, etc. of all devices.
  - h. All other shop drawings necessary to install, fabricate, locate, identify, test, service, and repair the systems provided.
7. Shop drawings approved by the Owner's Representative OR by the Consultant Engineer is not a release from Contract requirements as defined by the Drawings, Specifications, and governing codes and regulations.
- I. Samples:
1. Field Samples:
    - a. Wires and Cables: Submit a one (1) foot sample length of each wire and cable type to be used with the cable identification clearly shown.
    - b. Submit all required samples along with the product data submittal for review and approval prior to installation.
    - c. If all wire samples cannot be submitted at the same time, submit samples with a complete list of all cables to be used noting samples which have been submitted. Update the list with each subsequent sample submittal.
  2. Devices/Equipment:
    - a. If required by Owner, submit sample assemblies of each of the following devices or equipment along with the product data submittal for review and approval by the Owner's Representative:
      - 1) Substituted products if requested by Owner.
      - 2) Custom component, board, equipment or assembly.
  3. Disposition: Submitted samples become property of the Owner and will not be returned.
  4. Approval of any custom or modified assemblies shall be required. Submit technical information with samples.
- J. Test Procedures:
1. Initial Performance Testing: Submit test procedures, forms, and checklists for point-by-point testing. Include a listing for each individual system, each control station and control panel, each equipment room, and each major system component. At a minimum, forms shall include columns for operational/non-operational status, remarks, workmanship, and

date corrected. Submit a sample format for approval by the Owner's Representative a minimum of 20 days prior to testing.

2. Performance Verification Testing: Submit test forms which are identical to or similar to the accepted Initial Performance Testing forms. Obtain approval from the Owner's Representative for any changes in test procedure or forms.

**K. Test Results:**

1. Performance Verification Testing: Submit completed test results prior to or with the request to have the project declared substantially complete by the Owner.

**L. Record (As-Built) Documents:**

1. Maintain a current record set of as-built drawings on the job and as construction and installation progress, show the actual installed location of all items, material, and equipment.
2. Accurately record actual routing of all conduits including sizes and types.
3. The as-built drawings shall be available to the Owner's Representative for review and will be required for evaluation of progress payments.
4. Submit as-built shop drawings created from the approved shop drawings and updated from the site as-built drawing set and any other drawings required to depict the as-built conditions of the installed work.

**M. Operational Manuals:**

1. Submit the required quantity of identical manuals, which shall contain the Theory of Operation, start up, shut down and emergency procedures, and the manufacturer's operating instructions.
2. Subdivide the manual by section with tab dividers. Provide a table of contents which identifies each section and the contents therein.
3. Submit an electronic copy.

**N. Maintenance Manuals:**

1. Submit a complete set of maintenance documents as described in this Section. For documents of sizes greater than 11 x 17 inches, prints and electronic copy shall be furnished.
2. Manuals shall include the following as a minimum requirement:
  - a. Technical system description.
  - b. System schematics.
  - c. Detailed wiring diagrams to identify cabling, termination, and routing.
  - d. Panel assembly drawings to identify location of components, terminal strips, and equipment as required to correlate with system drawings.
  - e. Descriptions and drawings as required to maintain equipment from the board to the component level.
  - f. Description of software and user programmable functions. Procedures for user programmable functions shall be included.
  - g. A complete electronic copy of each unique system program.

3. For systems where the program resides on electronic media or other similar storage medium, furnish a copy of the media, or similar medium, to the Owner's Representative.
4. Where multiple systems are combined into a single integrated system, documentation shall include a description of the integrated system and the details of the interfaces between systems.
5. Provide a list of current telephone numbers and addresses of all material vendors and equipment manufacturers who have supplied components in this Project. Include separate service telephone list and purchasing telephone list cross-referencing with each component.

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

- A. Protect all materials and equipment from damage during storage at the site and throughout the construction period. Protect equipment and materials during shipment and storage against physical damage, dirt, dust, moisture, cold, rain, and any foreign substances that may damage the equipment.
- B. Prevent damage from rain, dirt, sun and ground water by storing the equipment on elevated supports and covering them on all sides with securely fastened protective rigid or flexible waterproof coverings.
- C. Protect conduit by storing it on elevated supports and capping the ends with suitable closure material to prevent dirt accumulation.
- D. Protect all fabricated and/or installed materials and equipment against dust, dirt, moisture, physical damage, metal debris, and any foreign substances that may damage the equipment.
- E. Protect painted surfaces with removable heavy Kraft paper, sheet vinyl or equal, installed at the factory and removed prior to final inspection.
  1. Replace equipment determined by the Owner's Representative to be damaged. Repaint and finish damaged paint on equipment and materials with the same quality of paint and workmanship used by manufacturer so that repaired areas are not obvious.

### **1.10 SITE CONDITIONS**

- A. Site Investigation
  1. Prior to commencement of work, the Contractor shall perform a site survey of all related existing systems and submit any potential problems of the design documents that may increase the installation cost of the project.
  2. Survey all locations where work is to be performed and verify existing conditions prior to shop drawing submittals.
- B. Coordination with Security Personnel

1. The owner will assign a contact person for the contractor to coordinate day to day activities and access into areas. Coordinate all system interruptions and scheduled down time with the contact person.

C. Security Requirements

1. Any special security requirements will be provided by the Owner. See Division 1.

## 1.11 SEQUENCING AND SCHEDULING

A. General Requirements:

1. Do not begin the project without the Owner's acceptance of proposed key project personnel for the Division 28 Work.
2. Prepare, review, and coordinate with the Owner's Representative an approved construction (CPM) work schedule. Schedule work in areas and at times that will not interfere with scheduled activities as defined by the Owner's Representative.
3. Provide weekly short term (4-week schedule) updates to Owner's Representative showing day to day progress and impact to occupied areas.
4. Do not procure any equipment without accepted product data submittals. Do not perform any field installation without accepted shop drawings. Do not begin any extensive software development or programming without accepted system, operational narratives, the required Owner's coordination, and user's requirements.
5. Pre-assemble control electronics, control panels, racks, and cabinets off-site as most practical.
6. Install system control equipment, control panels, cabinets, racks, and consoles only after major construction in the area in which they are to be installed has been completed and areas have been cleaned, painted, and sealed.
7. After systems installation and prior to point-by-point performance testing, thoroughly pre-test all devices and device wiring for proper performance. Then, thoroughly pre-test each system function in each state or condition under every operating mode.

B. Coordinate all work in the existing facility with the facility contact person.

## 1.12 WARRANTY

- A. The Contractor is to provide a warranty of the work provided under this contract (including, but not limited to, software, hardware, and peripheral equipment) as a system, including interfaces to work by others for **one year** from the date of Acceptance of the Work. Specific Division 28 sections may require longer warranty periods. Divisions of work among various suppliers, vendors, installers, subcontractors, and other parties will not be recognized or accepted.
- B. Extended Warranty: Provide itemized pricing for an Extended Service and Warranty for years 1, 2, and 3 after the initial warranty period. Describe whether all parts and labor are included in this offering.
- C. Guarantee to repair and replace defective materials or workmanship during the warranty period including labor and materials.

- D. An emergency maintenance (Warranty) request shall be defined as a system or portion of a system failure that affects building safety, security, and operation of critical components, including any access controlled door, which by failing, prevents entry into a building space through other means or direction. Failure of a single component (i.e., duress button, access controlled door which does not prevent access to a space through other means or direction, camera, or monitor) is not considered an emergency maintenance request.
- E. Respond within four hours to an emergency maintenance request. Provide a twenty-four hour telephone contact number (24 hours per day, 365 days per year). Service response time is defined as the period between the placing of a service request and the arrival of a qualified technician capable servicing the problem on-site.
- F. Maintain a sufficient parts inventory within 50 miles of the project during the warranty period to meet the guaranteed system repair times.
- G. Repair and make operational any defective materials or workmanship resulting from an emergency maintenance request within an 8-hour period from the time of the initial arrival of service personnel at the site. Correct non-emergency defective materials or workmanship within four (4) calendar days of receiving notice of the defect.
- H. Where the equipment manufacturer's warranty covers a longer time period than that required by these Specifications, the manufacturer's warranty shall govern.

### **1.13 EXTRA MATERIALS**

- A. Prior to Acceptance of the Work, deliver to the Owner all spare parts and extra materials required in each Section. All spare parts and extra materials shall be brand new in their original shipping boxes or packages and shall have one year material warranty remaining at the time of delivery. Extra materials shall be available to the Contractor to use as immediate replacements during the warranty period. All extra materials used for the warranty requirements shall be replaced by the Contractor.
- B. Special Tools:
  - 1. Provide three of each type of security screw bits used.
  - 2. Provide minimum of one of any specialty tools used.

## **PART 2 - PRODUCTS**

### **2.1 PRODUCT OPTIONS AND SUBSTITUTIONS**

- A. Comply with the General and Supplementary Conditions and Division 1 Specifications.
- B. The products named in this section and the sections governed by this section establish minimum qualities that substitutions must meet to be considered acceptable. The specified products have also been used in preparing the drawings and specifications, and therefore establish the basis for equipment sizing, wire and cable design, power consumption, and other design parameters.

- C. Substitution requests, if permitted, will be considered only if submitted in strict accordance with the followings:
1. Cross-reference submitted items to the Specifications using their related Section and paragraph number.
  2. Submit complete product data, descriptive literature, catalog cuts, illustrations, schematics, technical data sheets, and test data necessary for the Owner's Representative to ascertain that proposed equipment and materials comply with specification requirements. Include manufacturer's name, model, catalog or part numbers. Catalog cuts shall be legible and shall clearly identify equipment being submitted.
  3. Disclosure of Product Deviations: Specifically identify and tabulate any and all deviations from the contract documents including all system functions and features. Reference the corresponding specification sections and paragraph/article numbers. All variances and deviations will be reviewed for acceptance or rejection. It will be the Contractor's sole responsibilities to comply with all other contract requirements not revealed in the disclosure of product deviations.
- D. The Contractor shall take full responsibility for all design, coordination, and cost associated with substitutions including, but not limited to:
1. Its integration into the total system including physical mounting space, electrical interconnection, signal wiring, power, quality, electromagnetic interference, communication protocols, and similar design considerations.
  2. Any additional materials, equipment, components, accessories, items required for equivalent system operation and performance.
  3. Any necessary changes to branch power circuits, circuit protective devices, and the Work of other trades.
  4. Any modifications to wire, cable, and raceway design.

## **2.2 MATERIALS AND EQUIPMENT**

- A. All equipment and materials required for installation under these Specifications shall be new and without blemish or defect.
- B. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacturing of such items, for which replacement parts are available. Specifications are prepared long in advance of project construction; the contractor is to use the newest model of the specified products available at bid time.
- C. All material and equipment shall be listed, labeled, or certified by Underwriters' Laboratories, Inc., where such standards have been established. Equipment and material which are not covered by UL Standard will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe will be considered, if inspected or tested in accordance with national industrial standards such as NEMA or ANSI.

- D. All parts of a system shall be the product of one manufacturer. When more than one unit of the same class of equipment or material is required, such units shall be the products of a single manufacturer. Constituent parts which are similar shall be the product of a single manufacturer.
- E. All components of an assembled unit need not be products of the same manufacturer; however, all components must be acceptable to the Owner's Representative. Components shall be compatible with each other and with the total assembly for the intended service.

### **2.3 EQUIPMENT MODIFICATIONS:**

- A. When standard manufactured equipment is modified from its original condition or factory options have been exercised identify the changes as noted below.
  - 1. Clearly identify the modifications on the shop drawings.
  - 2. Clearly identify each piece of modified equipment with a label, which states, "This unit has been modified..." and identify the modification or reference. Locate the label so that a service technician or factory service personal will be able to determine the equipment in use is non-standard and that modifications are required for service, testing and replacement.
  - 3. Identify and describe the modifications on the Record Documents.
- B. Equipment modification labels are not required for jumper or switch settings.

### **2.4 FABRICATION**

- A. Fabricate enclosures to easily accommodate interconnecting cables entering from above or below through the use of auxiliary gutters, cable trays, and conduits. Protect all metal cabinet edges where conductors cross and conduit ends with protective covering or bushing.
- B. Group wires and cables by types, boards and modules, and maintain National Electrical Code clearances throughout the installation, including Class 1, Class 2, communications, and branch circuit power separations. Maintain sufficient and proper separation between microphone-level audio, line-level audio, high-level audio, and video cables.
- C. Uniformly organize equipment and cable routing throughout all enclosures, racks, and cabinets. Provide wiring ducts, raceways, wire posts, D rings, wire saddles to route and secure factory and field wiring. Provide routing for all wiring from point of entry to point of termination to maintain required separation, access to all components, and general organization to the wiring. Neatly dress, route and secure wiring.
- D. Mechanically fasten cabinet raceways and cable clamps to enclosure rear panels, rack members, console members, or to other system components. The use of adhesive fasteners (without mechanical fastener) is not permitted. Furnish and install cable support posts where necessary to properly support cables.
- E. No splices are permitted in cabinet raceways. Exception: Splice to cable shield when within two inches of cable termination is permitted.

- F. Furnish and install metal grounding type outlet strips in each equipment cabinet, enclosure, and rack. Leave a minimum of two unused receptacles at each location for future expansion. Neatly shorten and dress power cords from individual equipment to the outlet strips.
- G. Provide protection from accidental contact of all terminals or exposed conductors over 25 volts within enclosures that contain Class 2 wiring. Use non-conductive barriers, heat shrink or other acceptable methods. Tape of any kind is not permitted.
- H. Provide an isolated ground bus within each equipment cabinet, enclosure, and rack for single point termination of audio and data shields and grounds.

## **2.5 SOURCE QUALITY CONTROL**

### **A. Shop Inspections:**

- 1. The Owner's Representative shall have the right at all times to inspect or otherwise evaluate the Work performed or being performed and shall have access to the premises in which the Work is being performed.
- 2. The Owner's Representative may verify the inspections or re-inspect any item. The Owner reserves the right to reject materials and workmanship found unacceptable during inspections.

### **B. Shop Test and Demonstration**

- 1. Shop Test and Demonstration shall be a major milestone that shall commence only after all shop assembly, system integration, and software development and programming is complete. Owner's approval of the integrated shop test shall be obtained before any system components are shipped to the site for installation.
- 2. Perform a point-by-point system demonstration of the Integrated Security System including surveillance system, duress alarm system, physical access control system, and audio announcement system to show all systems functioning and communicating as a single integrated system where required.
- 3. Notify the Owner a minimum of 15 working days prior to demonstration so that the Owner may witness the demonstration.
- 4. Conduct the demonstration in strict accordance with the test procedure accepted by the Owner. Demonstrate full compliance with the required operating modes and sequences of operation under all operating modes. Record demonstration/ test results on a report which shall include a list of all personnel witnessing the demonstration, test methods used, and a record of each specific test made.
- 5. If demonstration results are not in compliance with requirements, make necessary hardware and software changes, corrections, repairs, or adjustments at no additional cost to the Owner. If corrections cannot be made during the scheduled Shop Test and another shop test is required, the Contractor shall pay for all transportation, lodging and expenses of the Owner's representatives' (maximum seven people) attending the additional tests. This process shall continue until the systems are acceptable to the Owner.



## 2.6 FIRESTOPPING/SEALANT MATERIALS

- A. Firestop and seal all penetrations of fire walls with minimum three hour sealant or Fire Stop Putty(FSP). This includes but is not limited to all raceway, conductor, sleeve and cable tray penetrations where penetrating device does not completely seal the hole.
- B. Accepted Products: International Protective Coatings Corp. FlameSafe FSP 1100, Nelson FSP, Domtar Fire-Halt, or approved equal from other manufacturers.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Carefully inspect the installed Work by other trades and verify that all such Work is complete to the point where installation of the Work of this division may properly commence.
- B. In the event of discrepancy, immediately notify the Owner's Representative. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.
- C. Install all equipment in accordance with all pertinent codes and regulations, the accepted design, and the referenced standards.

### 3.2 INSTALLATION

- A. Equipment Identification:
  - 1. Install a nameplate on each individual equipment rack, enclosure, boxes, cabinet, and significant equipment item.
  - 2. Use identifiers and abbreviations defined in the Drawings whenever possible. Use plan designation for labeling, unless indicated otherwise.
  - 3. Nameplates shall be laminated black phonemic resin with a white core and engraved lettering, a minimum of 1/4" high.
  - 4. Engrave using upper case letters of uniform height; centered on device, cover plate, or enclosure; with all characters made clearly and distinctly.
  - 5. All equipment shall have the manufacturer's name, address, model number and rating on a name plate securely affixed in a conspicuous place. All equipment shall bear labels attesting to Underwriters Laboratories approval where subject to Underwriters Laboratories label service.
  - 6. Identify all field terminals and relays with device identification. Lettering shall be 3/16" high minimum.
- B. Equipment Installation:
  - 1. Install all equipment in accordance with the manufacturer's recommendations, and accepted shop drawings.
  - 2. Install all equipment in compliance with CEC requirements, NECA's "Standard of Installation", and recognized industry practices.

3. If requested, submit structural and seismic mounting load calculations demonstrating adequate support and bracing for seismic zone 4.
4. Do not attach electrical materials to roof decking, removable or knockout panels, or temporary walls and partitions unless indicated otherwise. Use hangers and other supports to support the equipment and materials, intended for this purpose.
5. Locate equipment as close as practical to the locations shown on the Drawings.
6. Maintain minimum 3-foot working clearances on each side of equipment or equipment racks where access is required to inspect, service or adjust.
7. Check equipment against available mounting space indicated on the drawings. Coordinate location of equipment with existing devices to minimize interference. Bring all conflicts or clearance problems to the attention of the Owner's Representative during the preparation of shop drawings.
8. Where the Owner's Representative determines that equipment installation is not conveniently accessible for operation and maintenance, remove and reinstall equipment in a conveniently accessible manner at no extra cost.

C. Grounding and Shielding:

1. Comply with Section 27 05 26.

D. Surge Suppression:

1. Comply with Section 27 05 26.

### 3.3 FIELD QUALITY CONTROL

A. Initial Performance Testing:

1. Initial Performance Testing is to be conducted by the Contractor.
2. Point-by-point testing shall include the sequential operation of each system and control function in each of its operating modes. All tests are to be conducted and recorded per the accepted procedure and test forms.
3. Notify the Owner's Representative ten days in advance that this activity will be occurring.

B. Performance Verification Testing:

1. Performance Verification Testing (PVT) is to be conducted by the Contractor and witnessed by the Owner's Representative.
2. Schedule point-by-point PVT only after Initial Testing has been satisfactorily completed and all necessary corrections have been made. Provide the Owner's Representative with a minimum of 10 working days' notice with a request to schedule PVT. Submit Initial Performance Test records prior to the scheduled PVT. Failure to submit test results as specified shall be cause to re-schedule testing.
3. Point-by-point testing shall include the sequential operation of each function in each of its operating modes, in addition to completion of all required performance testing and measurement.
4. Conduct point-by-point PVT testing in the presence of Owner's Representative. Record test results on the accepted test checklist which shall include a list of all personnel witnessing the tests. If test results are not in compliance with requirements, make

necessary changes or adjustments at no additional cost, and arrange for another test. This process shall continue until the systems are acceptable to the Owner's Representative.

5. Failure of any part of the system which precludes completion of system testing, which cannot be repaired in four (4) hours, shall be cause for terminating the test. Retesting of the entire system shall be rescheduled at the convenience of the Owner, and Contractor shall bear the Owner's costs to complete retesting.
6. PVT will also include inspections for contract document compliance, codes and standards compliance, and workmanship.

### **3.4 CLEANING**

- A. Comply with Division 1 requirements.
- B. Protect equipment during installation against entry of foreign matter on the inside. Vacuum clean all equipment both inside and outside before testing, operating and painting. Clean electrical connections with a suitable solvent prior to assembly.
- C. Remove from the premises and dispose of all packing material and debris on a daily basis.
- D. Upon completion of the Work, remove excess debris, materials, equipment, apparatus, tools and the like and leave the premises clean, neat and orderly.
- E. Thoroughly polish all bright metal or plated Work and remove any pasted labels, dirt or stains from the equipment.

### **3.5 TRAINING**

- A. Provide on-site, project-specific training sessions for system operations, maintenance, and programming with designated total hours as follows:

	Administrative	Operator
1. Video Surveillance System	8/4/4	4/2/2
2. Access Control System	8/4/4	4/2/2
3. Duress Alarm System	1/NA	1/NA

- B. All classroom training is to occur on site at a location provided by the Owner.
- C. All training is to review the existing systems as they apply to the equipment and systems provided under this contract. All personnel being trained are expected to have basic experience for the existing systems.
- D. Operator Training:
  1. Train security staff in the operation of the System. Operational training shall include how to monitor and control the systems provided under this contract and how to respond to system events.
- E. Administrator Training:

1. Train Owner's personnel in the site-specific programming and software trouble shooting of the System. Training will also include all user programmable features. Conduct training sessions using instructors who have been actively involved throughout construction and who are certified in writing by the manufacturers of the specific systems.
  2. Provide a combination of classroom sessions supported by audio/visual aids, and field sessions with personnel participating in hands-on for programming changes, software uploading/downloading, trouble shooting, etc.
  3. Train Owner's personnel in the basic user level maintenance and trouble shooting of the System. Structure training to identify the equipment and systems that can be serviced or reset by the on duty building engineer, how to identify systems that have failed or not working, and emergency shut down procedures.
  4. Provide a combination of classroom sessions supported by audio/visual aids, and field sessions with personnel participating in hands-on preventative, corrective maintenance and reactive maintenance.
- F. Submit an estimated training schedule 15 days prior to training for approval by the Owner's Representative. Estimate classroom and hands-on hours required for all three types of training (operational, maintenance, and programming). Include a syllabus for each class session. Provide video recording, minimum 720p, of the training sessions on solid-state media.
- G. All training materials including Operational and Maintenance (O&M) Manuals shall be reviewed and approved prior to conducting the specific training.

**SCHEDULE 28 05 00A**

**SAMPLE LIST OF DIVISION 28 SUBMITTALS**

1. CPM Schedule
2. Submittal Matrix
3. Schedule of Values (SOV)
4. Licenses and certifications
5. Key Project Personnel
6. Product Data
7. Shop Drawings
  - a. Floor Plans
  - b. Enlarged Control / Equipment Rooms and Elevations
  - c. Rack and Cabinet Elevations
  - d. Block Diagrams
  - e. Single Line Diagrams
  - f. Point- to-Point Diagrams
  - g. Schematic Diagrams
  - h. Installation Diagrams and Details
8. Calculations; UPS, Data
9. Sequence of Operations
10. Samples
11. Test Procedures
12. Test Results
13. Record Documents
  - a. Drawings
  - b. O&M Manuals
  - c. Warranty
14. Extra Materials

**SCHEDULE 280500 B**

**SUMMARY OF REQUIRED LICENSES AND CERTIFICATIONS**

This list is provided for the convenience of the Contractor only.

- A. Section 28 05 00 Integrated Systems Contractors
  - 1. Key Personnel Degree or equal
  - 2. Local Contractors License
  - 3. Qualifications of licensed electrician performing work onsite.

**END OF SECTION 28 05 00**

## SECTION 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEM

### PART 1 - GENERAL

#### 1.1 INTENT

- A. It is the intent of the Owner to enter into a contract with a qualified contractor to have that contractor procure, provide, install, and make fully operational a Physical Access Control System (PACS) with operational characteristics and capabilities which meet or exceed the product specification and technical performance parameters contained within this document and shown on the project drawings.
- B. This PACS shall be installed in Building MM as shown on the project drawings.

#### 1.2 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. Division 8 Door Locking Hardware
- C. Section 28 05 00 Common Work Results for Electronic Security Systems
- D. Section 28 23 00 Video Surveillance System

#### 1.3 SUMMARY

- A. Section includes a physical access control system consisting of credentials, proximity card readers, door position switches, request to exit sensors, IP compatible door controllers, headend software system, workstations, and door locking hardware (door locking hardware by Div 8 Contractor).
- B. Physical access control system shall be integrated with systems specified in:
  - 1. Division 8 Door Locking Hardware
  - 2. Section 28 23 00 Video Surveillance System

#### 1.4 DEFINITIONS Retain definition(s) remaining after this Section has been edited.

- A. Access Level: An authorization level or security criteria that must be met before access to a controlled space is granted
- B. Access Point: A point of entry into a secure area, typically managed by a door controller and a card reader.
- C. ACS: Access Control System

- D. ALPR: License Plate Recognition
- E. API: Application Programming Interface
- F. Biometrics: A machine readable technology that identifies individuals based on reading features such as retinal scans, fingerprints, or other individualistic biological feature
- G. Credential: A card, token, keyfob, or other item which is encoded with information specific to an individual
- H. Door Controller: Device which integrates an access-controlled point to the system headend
- I. Door Strike: A door-frame mounted device which works with a mechanical lock or latch mechanism
- J. DGM: Dynamic Graphical Maps
- K. Encoder: A device utilized to record data onto an access credential
- L. Fail Safe Access Point: A door that will unlock automatically in the event of a power failure to permit entering and exiting through the door.
- M. Fail Secure Access Point: An access point that automatically locks during a power failure, preventing anyone from entering, but allowing them to exit during an emergency.
- N. Input/Output (I/O) Device: An I/O device facilitates elevator control and multi-door monitoring (in/out only).
- O. IP-based Access Control: IP access control technology utilizes the network to provide secure network-controlled access and management of physical doors at a facility or location.
- P. Magnetic Lock (Mag Lock): A locking device that consists of an electromagnet and a strike plate that works in conjunction with a mechanical lock or latch mechanism and uses electromagnetic attraction to lock and unlock a door.
- Q. Mustering: An access control software feature that quickly verifies where individuals in a particular zone at a location for easy tracking and identification.
- R. PACS: Physical Access Control System
- S. PDF: Portable Document Format. The file format used by the Acrobat document-exchange-system software from Adobe.
- T. Proximity Card (Prox Card): A access control credential that is encrypted with proximity technology and can be read by a proximity reader without having to physically insert the card into the reader, in order to grant a cardholder access to a location.
- U. Power over Ethernet (PoE): PoE carries both power and data for the access control door controller and peripheral door hardware.



- V. PoE Injector: A Power over Ethernet (PoE) injector brings PoE capabilities to non-PoE network links.
- W. Request to Exit Sensor (REX): A button or device that must be activated to release the door in order to exit without triggering a forced door alert.
- X. SDK: Software Development Kit
- Y. SSM: Server Software Module
- Z. SMA: Software Maintenance Agreement
- AA. Smart Card – An access card that can be integrated with different technologies including biometric, magnetic stripe, proprietary proximity—and has a memory feature which can contain information about the cardholder.
- BB. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- CC. UI: User Interface
- DD. UPS: Uninterruptable Power Supply
- EE. VMS: Video Management System
- FF. WAN: Wide area network.
- GG. WAV: The digital audio format used in Microsoft Windows.
- HH. WMP: Windows media player.
- II. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.
- JJ. Windows: Operating system by Microsoft Corporation.
- KK. Workstation: A PC with software that is configured for specific, limited security-system functions.

## **1.5 ACTION SUBMITTALS**

- A. See Section 28 05 00 – Common Work Results for Electronic Security Systems

## **1.6 INFORMATIONAL SUBMITTALS**

- A. See Section 28 05 00 – Common Work Results for Electronic Security Systems

## **1.7 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For card readers, door position sensors, request-to-exit sensors,

VMS hardware / software, storage, and work station components include all operation, troubleshooting, and maintenance manuals. In addition to items specified above, include the following:

- B. See Section 28 05 00 – Common Work Results for Electronic Security Systems

## **1.8 WARRANTY**

- A. See Section 28 05 00 – Common Work Results for Electronic Security Systems

## **PART 2 - PRODUCTS**

### **2.1 QUALITY ASSURANCE**

- A. Manufacturer of any major component or system installed as a part of this project and not named as a basis of design shall have been in the business of manufacturing such component or system for a minimum of 5 years immediately preceding the date on this document.
- B. Any major component or system installed as a part of this contract and not named as a basis of design shall have been installed in a minimum of 3 successfully completed projects of a similar size and scope. Contractor shall supply reference information with their proposal including project name, project location, and contact information for the system end-user.

### **2.2 BASIS OF DESIGN**

- A. Where a specific manufacturer's product is listed below, such product's performance characteristics and capabilities constitute the minimum acceptable, and any suggested alternates shall have characteristics and capabilities which meet or exceed the product named as the basis of design. Contractor may propose alternate products as follows –
  - 1. See Section 28 05 00 – Common Work Results for Electronic Security Systems
    - a. Owner shall make every effort to review proposed alternate equipment, however there is no guarantee that the Owner will review the alternate equipment proposal before the bid opening date, and the Contractor assumes all risk in proposing any such alternates. In the event that the Contractor's alternate equipment is judged by the Owner to not be an acceptable substitute after the Contractor submits a bid, the Contractor shall be responsible for providing the basis of design specified equipment at no additional cost to the Owner.

### **2.3 PACS BASIS OF DESIGN TECHNICAL PERFORMANCE SPECIFICATIONS**

- A. System Headend – Existing Genetec Synergis by Owner.
- B. Card Reader (By Div.28) – Schlage
  - 1. Standard Wall – MTB15

2. Mullion Mount – MTB11
  - C. Door Controller (By Div.28) – SY-LP1501 as manufactured by Genetec / Mercury Hardware. House SY-LP1501 in Contractor provided Altronix TM-400 as shown on the project drawings.
  - D. Additional Input Board (By Div. 28) – SY-MR50-S3 as manufactured by Genetec. Install in TM400 with SY-LP1501)
  - E. Door Position Sensor (By Div.28) – 1076 As manufactured by GE / UTC.
  - F. Request-to-Exit Sensor – Per District standard REX shall be integral to door hardware unless door hardware schedule calls out for electric door strike, in which case Div. 28 Contractor shall provide and install DS-150i as manufactured by Bosch. Contractor shall refer to door schedule.
  - G. Telecom Cable (By Div.28) - Category 6A PoE++ as manufactured by Belden (typical 2 cables per data outlet).
  - H. Auxiliary PoE Power Supply – (By Div.28) Planet Technology IPOE 173S. Div. 28 scope shall be installation and cabling to the door frame side of the power transfer device.
  - I. Lockdown Button (By Div. 28) – SS2242-LD-EN (Illuminated Activation / Pull to Reset) as manufactured by Safety Technology. Lockdown buttons shall be added to any space typically occupied by 5 or more people. Utility spaces such as IDF/BDF, Electrical / Mechanical Closets, and Janitorial spaces do not typically receive a lockdown button.

## **2.4 POWER SUPPLIES**

- A. All door controllers and equipment connected to door controllers shall be PoE powered.

## **PART 3 - EXECUTION**

### **3.1 QUALITY ASSURANCE**

- A. Contractor shall be a factory authorized reseller / installer of all major components installed as a part of this project. Contractor shall submit proof of such authorization as a part of their bid package.
- B. Contractor shall have successfully completed a minimum of 3 projects similar in size and scope to this one and shall submit references for such projects with their bid package. Reference shall include project name, location, type of facility, system(s) installed, and end-user contact information. It is expected that substantially the same personnel will be assigned to this project as participated in the referenced projects. This would include the project engineer, project manager, and lead installation technician. If any of these personnel were not involved in the referenced project, Contractor shall supply resumes for these employees documenting their experience and qualifications related to this project.

- C. At a minimum, the lead installation technician assigned to this project shall be manufacturer certified in the installation of all major components installed as a part of this project.

### **3.2 SITE SPECIFIC SCOPES OF WORK**

- A. Division 28 Contractor shall provide and install access control devices as shown on the project drawings, details, and elevations. Include all associated field devices, controllers, cabling, conduit, boxes, connectors, and any other hardware, software, firmware, or license required to render access control system fully operational. Contractor shall coordinate with LBCC to integrate access control components installed as a part of this project with the existing District-wide Synergis access control software. Contractor scope shall include verification that all devices integrated into the existing Genetec platform function as intended.
- B. Division 28 Contractor shall be responsible for terminating electrified door hardware power supply cabling to the frame side of the power transfer device.
- C. Division 28 contractor shall configure system to not release lockdown until initiating lockdown button has been reset and authorization from senior management has been received.

### **3.3 EXAMINATION**

- A. Examine pathway elements intended for system cabling. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation and / or operation, and other conditions affecting installation.
- B. Examine roughing-in for LAN, WAN, and IP network before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.4 WIRING**

- A. See Section 28 05 00 – Common Work Results for Electronic Security Systems

### **3.5 CONTROL SYSTEM INSTALLATION**

- A. PACS device locations shown on drawings are approximate, and Contractor shall verify final position with the Owner before any work is done.
- B. Install all PACS components per manufacturer's installation instructions.
- C. Install key locks on any field enclosures
- D. Identify system components, wiring, cabling, and terminals according to Section 26 05 53 "Identification for Electrical Systems", and Section 28 05 00 – "Common Work Results for Electronic Security Systems". In instances where there is a discrepancy between 26 05 53 and 28 05 00, the more stringent requirement shall apply.

### **3.6 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. Tests and Inspections:
  - 1. See Section 28 05 00 – Common Work Results for Electronic Security Systems
- C. Performance Verification Test Schedule: See Section 28 05 00 – Common Work Results for Electronic Security Systems
- D. Physical access control system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### **3.7 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of full system acceptance, or, when the date when Owner has acknowledged the system as being fully functional and in use, whichever is later, Contractor shall provide on-site assistance in adjusting system to suit actual occupied conditions, as directed by the District. This shall be in addition to any warranty service calls. Provide TWO (2) visits to Project during normal business hours for this purpose. Tasks shall include, but are not limited to, the following:
  - 1. Check cable connections.
  - 2. Check proper operation of readers and doors.
  - 3. Check proper operation of all integration driven functionalities.
  - 4. Perform various modifications and adjustments to the system functionality as requested by the Owner or their appointed representative.

### **3.8 CLEANING**

- A. Clean installed items using methods and materials recommended in writing by manufacturer.
- B. Clean PACS components as needed.

### **3.9 TRAINING**

- A. Training on the surveillance system shall be as follows:
  - 1. See Section 28 05 00 – Common Work Results for Electronic Security Systems

**END OF SECTION 28 13 00**

## SECTION 28 23 00 - VIDEO SURVEILLANCE SYSTEM

### PART 1 - GENERAL

#### 1.1 INTENT

- A. It is the intent of the Owner to enter into a contract with a qualified contractor to have that contractor procure, provide, install, and make fully operational an Electronic Video Surveillance System (EVSS) with operational characteristics and capabilities which meet or exceed the product specification and technical performance parameters contained within this document and shown on the project drawings.
- B. This EVSS shall be installed in Building MM as shown on Contract Drawings.

#### 1.2 SUMMARY

- A. Section includes a video surveillance system consisting of:
  - 1. Fixed Interior Wall / Ceiling Mount Megapixel Camera
  - 2. Fixed Exterior Wall / Pole Mount Megapixel Camera
  - 3. Genetec Digital Video Recording and Management Software (DVRMS) *Existing, NIC*
  - 4. System Servers *Existing, NIC*
  - 5. System Workstations / Review Monitor *Existing, NIC*
  - 6. Power and Data Cabling, Conduit, and Infrastructure
- B. Video surveillance system shall be integrated with systems specified in:
  - 1. Section 28 1300: Physical Access Control System
  - 2. Section 28 1600: Intrusion Detection System

#### 1.3 RELATED SECTIONS

- A. Section 28 0500: Common Work Results for Electronic Security Systems
- B. Section 28 1300: Physical Access Control System

#### 1.4 ABBREVIATIONS AND ACRONYMS

- A. Following abbreviations and acronyms apply to this Section:
  - 1. CPU = Central Processing Unit
  - 2. DVD = Digital Video Disc
  - 3. DVRMS = Digital Video Recording and Management System
  - 4. FPS = Frames per Second
  - 5. GB = Gigabyte
  - 6. GBPS = Gigabyte per Second

7. HDD = Hard Disk Drive
8. HDMI = High Definition Media Interface
9. IDS = Intrusion Detection System
10. IPS = Images per Second
11. LAN = Local Area Network
12. MB = Megabyte
13. MBPS = Megabyte per Second
14. NAS = Network Attached Storage
15. LED = Light Emitting Diode
16. PACS = Physical Access Control System
17. RAID = Redundant Array of Independent Disks
18. RAM = Random Access Memory
19. SAN = Storage Attached Network
20. TCP/IP = Transport Control Protocol / Internet Protocol
21. UPS = Uninterruptable Power Supply
22. USB = Universal Serial Bus
23. PVT = Performance Verification Testing
24. V-LAN = Virtual Local Area Network
25. VMS = See DVRMS
26. VSS = Video Surveillance System
27. WAN = Wide Area Network

## **1.5 REFERENCE STANDARDS**

- A. Following reference standards apply to this Section:
1. National Television System Committee - NTSC (North America)
  2. Joint Photographic Experts Group – JPEG
  3. Motion Joint Photographic Experts Group - MJPEG
  4. Moving Picture Experts Group - MPEG
  5. Underwriters Laboratory – UL
  6. Federal Communications Commission – FCC
  7. Interference Causing Equipment Standard – ICES (Canada)
  8. Institute of Electronic and Electrical Engineers - IEEE
  9. International Standards Organization – ISO
  10. International Electrotechnical Commission -IEC
  11. Restriction of Hazardous Substances Directive (RoHS)

## **1.6 ACTION SUBMITTALS**

- A. See Section 28 05 00 Common Work Results for Electronic Security Systems

## **1.7 INFORMATIONAL SUBMITTALS**

- A. See Section 28 05 00 Common Work Results for Electronic Security Systems

**1.8 CLOSEOUT SUBMITTALS**

- A. See Section 28 05 00 Common Work Results for Electronic Security Systems

**1.9 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. Comply with NECA 1.
- C. Comply with NFPA 70.

**1.10 WARRANTY**

- A. See Section 28 05 00 Common Work Results for Electronic Security Systems

**PART 2 - PRODUCTS**

**2.1 QUALITY ASSURANCE**

- A. Manufacturer of any major component or system installed as a part of this project and not named as a basis of design shall have been in the business of manufacturing such component or system for a minimum of 5 years immediately preceding the date on this document.
- B. Any major component or system installed as a part of this contract and not named as a basis of design shall have been installed in a minimum of 3 successfully completed projects of a similar size and scope. Contractor shall supply reference information with their proposal including project name, project location, and contact information for the system end-user.

**2.2 BASIS OF DESIGN**

- A. Where a specific manufacturer's product is listed below, such product's performance characteristics and capabilities constitute the minimum acceptable, and any suggested alternates shall have characteristics and capabilities which meet or exceed the product named as the basis of design. Contractor may propose alternate products as follows:
  - 1. See Section 28 0500 Common Work Results for Electronic Security Systems

**2.3 EVSS BASIS OF DESIGN TECHNICAL PERFORMANCE SPECIFICATIONS**

- A. All cameras shall be by Axis.
  - 1. Substitutions are not permitted.



2. Individual camera part numbers and mounting type are per camera schedule.

## **2.4 POWER SUPPLIES**

- A. All system components to be connected to a UPS providing a minimum of 4 hours back-up power.

## **PART 3 - EXECUTION**

### **3.1 QUALITY ASSURANCE**

- A. Contractor shall be a factory authorized reseller / installer of all major components installed as a part of this project. Proof of such authorization shall be submitted as a part of the bid package
- B. Contractor shall hold licenses as required by local, state, or federal agencies.
- C. Contractor shall have successfully completed a minimum of 3 projects similar in size and scope to this one, and shall submit references for such projects with their bid package. Reference shall include project name, location, type of facility, system(s) installed, and end-user contact information. It is expected that substantially the same personnel will be assigned to this project as participated in the referenced projects. This would include the project engineer, project manager, and lead installation technician. If any of these personnel were not involved in the referenced project, Contractor shall supply resumes for these employees documenting their experience and qualifications related to this project.
- D. At a minimum, the lead installation technician assigned to this project shall be manufacturer certified in the installation of all major components installed as a part of this project.

### **3.2 SITE SPECIFIC SCOPES OF WORK**

- A. Contractor shall provide and install video surveillance cameras as shown on the project drawings. Include all associated cabling, conduit, and any other item required to render cameras fully operational. Contractor shall coordinate with LBCC to integrate surveillance cameras installed as a part of this project with the existing District-wide Genetec Video Management System.

### **3.3 EXAMINATION**

- A. Examine pathway elements intended for EVSS cabling. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation and / or operation, and other conditions affecting installation.
- B. Examine roughing-in for all components before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.4 WIRING**

- A. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- B. Wiring Method: Install cables in raceways and or conduit unless otherwise indicated.
  - 1. Except raceways are not required in accessible indoor ceiling spaces and attics, where Contractor shall utilize self-supported J-hooks.
  - 2. Except raceways are not required in hollow gypsum board partitions.
  - 3. Conceal raceways and wiring except in unfinished spaces.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- D. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. 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.
- E. For LAN connection and fiber-optic and copper communication wiring, comply with:
  - 1. Section 27 13 13 "Communications Copper Backbone Cabling"
  - 2. Section 27 13 23 "Communications Optical Fiber Backbone Cabling"
  - 3. Section 27 13 33 "Communications Coaxial Backbone Cabling"
  - 4. Section 27 15 00 "Communications Horizontal Cabling."
- F. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

### **3.5 ELECTRONIC VIDEO SURVEILLANCE SYSTEM INSTALLATION**

- A. EVSS device locations shown on drawings are approximate, and Contractor shall verify final position with the Owner before any work is done.
- B. Install all EVSS components per manufacturer's installation instructions.
- C. Install control panel at location as directed by the Owner.
- D. Install key locks on all enclosures
- E. Identify system components, wiring, cabling, and terminals according to Section 26 05 53 "Identification for Electrical Systems."

### **3.6 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. Tests and Inspections:

1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
2. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Prepare IDS equipment for acceptance and operational testing as follows:
  - a. Prepare equipment list described in "Informational Submittals" Article.
  - b. Verify operation of all cameras.
  - c. Verify proper recording and playback functionality.
  - d. Verify proper operation of workstation with EVSS headend / software for logging alerts and events.
  - e. Verify all integration functionality with Access Control and Intrusion Detection Systems.
3. Performance Verification Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 14 working days' notice of test schedule.
  - a. Contractor shall prepare and submit to the Owner a PVT plan showing a structured and complete testing procedure. This PVT plan shall be submitted to the Owner a minimum of 14 working days prior to planned start of testing.
  - b. PVT plan shall show equipment being tested, means of testing, and pass/fail criteria.
  - c. PVT form shall include space for Contractor / Owner initials on each testing phase, along with a signature page with PVT results and follow-up notes.
4. Should any component of the system fail TWO (2) consecutive PVT tests, the Contractor shall be liable for costs incurred by the Owner to provide personnel for further PVT testing.

C. Electronic video surveillance system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

### 3.7 ADJUSTING

- A. 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 (2) visits to Project during normal business hours for this purpose. Tasks shall include, but are not limited to, the following:
1. Check cable connections.
  2. Check proper operation of cameras and VMS
  3. Check proper operation of all integration driven functionalities.

**3.8 CLEANING**

- A. Clean installed items using methods and materials recommended in writing by manufacturer.
- B. Clean EVSS components as needed.

**3.9 TRAINING**

- A. See Section 28 05 00 Common Work Results for Electronic Security Systems

**END OF SECTION 28 23 00**

## **SECTION 28 31 11 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM**

### **PART 1 - GENERAL**

#### **1.1 SCOPE:**

- A. This specification describes a Campus Wide Fire Detection and alarm system with a site reporting system. The control panel, to be intelligent device addressable, analog detecting, low voltage and modular, with digital communication techniques, in full compliance with all applicable codes and standards. This system shall operate as a stand-alone panel, and if needed with transponders operation to meet the systems requirements. The features and capacities described in this specification are required as a minimum for this project and shall be furnished by the successful contractor.
- B. The system described shall operate with a Network Command Center monitoring and controlling systems in a peer-to-peer configuration, which shall allow interaction between each system, connected to the network.
- C. The system shall be in full compliance with National and Local Codes (2019 CBC, CEC, CFC).
- D. The system shall include all required hardware, piping, raceways, interconnecting wiring and software to accomplish the requirements of this specification and the contract drawings, whether or not specifically itemized herein.
- E. All equipment furnished shall be new and the latest state of the art products of a single manufacturer, engaged in the manufacturing and sale of analog fire detection devices for over ten years.
- F. The system as specified shall be supplied, installed, tested and approved by the local Authority Having Jurisdiction, and turned over to the owner in an operational condition.

#### **1.2 QUALIFICATIONS OF INSTALLERS:**

- A. Before commencing work, submit data showing that the manufacturer has successfully installed fire alarm and suppression systems of the same scope, type and design as specified.
- B. The contractor shall submit copies of all required Licenses and Bonds as required in the State having jurisdiction.
- C. The contractor shall employ on staff a minimum of one NICET level II technician or a professional engineer, registered in the State of the installation.

#### **1.3 MANUFACTURER'S REPRESENTATIVE:**

- A. Provide the services of a factory trained and certified representative or technician, experienced in the installation and operation of the type of system provided. The representative shall be

licensed in the State if required by law. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. The technician shall provide the required instruction to the owner's personnel in the system operation and maintenance.

- B. Contractor shall maintain a factory trained service department with service personnel available on a 24 hour, 7-day per week basis. Provide a 24-hour emergency service number with a maximum telephone response time of 1 hour.
- C. Contractor shall maintain a spare parts inventory of critical function components.
- D. Contractor's personnel shall have a minimum of two years experience in service and maintenance of fire detection, and alarm systems.

#### **1.4 SYSTEM REQUIREMENTS:**

- A. Local Fire Alarm Control Panel shall have the following;
  - 1. The system shall be a complete, electrically supervised fire detection and notification system, microprocessor based operating system having the following; capabilities, features and capacities:
    - a. Audible and visual notification alarm circuit zone control.
    - b. Status indicators for sprinkler system water-flow and valve supervisory devices.
    - c. Each intelligent addressable device on the system shall be displayed at the Control Panel Display.
    - d. Remote annunciators shall have alphanumeric display with the same characteristic as the fire alarm control panel. The remote display shall be programmable to have complete system control or just as an annunciator.
- B. The Network Command Center (NCC) system shall have the following;
  - 1. The system shall be "UL" listed computer and monitor with software to control the complete system as designed, electrically supervised with remote listed fire detection and notification systems. The system software shall be Windows NT based.
  - 2. The operating system having the following; capabilities, features and capacities:
    - a. Multiple Control Options, Mouse, Keyboard, Touch Screen, On-Screen Keyboard
    - b. Campus communication with same type systems in peer-to-peer configuration.
    - c. Multiple building reporting to one command site
    - d. Long distance communications, hardwire, dedicated phone lines and fiber optics.
    - e. Complete monitoring and control for up to 63 remote systems
    - f. Graphics capabilities
    - g. Up to Four (4) Network Command Centers

## 1.5 SYSTEM OPERATION:

- A. Activation of any system fire, supervisory, trouble, or status initiating device on the local panel shall cause the following actions at the panel annunciator.
- B. Fire Alarm Condition:
  - 1. Sound an audible alarm and display a custom screen/message defining the building in alarm and the specific alarm point initiating the alarm at the NCC.
  - 2. Log to the system history archives all activity pertaining to the alarm condition.
  - 3. Sound the ANSI 117-1 signal with synchronized audibles and synchronized strobes throughout the facility.
  - 4. Audible signals shall be silenced from the fire alarm control panel by an alarm silence switch. Visual signals shall be programmable to flash until system reset or alarm silencing, as required.
  - 5. A signal dedicated to sprinkler system water flow alarm shall not be silenced while the sprinkler system is flowing at a rate of flow equal to a single head.
  - 6. Record within system history the initiating device and time of occurrence of the event.
  - 7. Transmit the alarm signal information to the Network Command Center system with the system ID/Location and the alarm information.
- C. Supervisory Condition:
  - 1. Display the origin of the supervisory condition report at the fire alarm control panel.
  - 2. Activate supervisory audible and dedicated visual signal.
  - 3. Audible signals shall be silenced from the control panel by the supervisory acknowledge switch.
  - 4. Record within system history the initiating device and time of occurrence of the event.
  - 5. Transmit the supervisory signal information to the Network Command Center system with the system ID/Location and the alarm information.
- D. Trouble Condition:
  - 1. Display at the local fire alarm control panel, the origin of the trouble condition report.
  - 2. Activate trouble audible and visual signals at the control panel and as indicated on the drawings.
  - 3. Audible signals shall be silenced from the fire alarm control panel by a trouble acknowledge switch.
  - 4. Trouble reports for primary system power failure to the master control shall be automatically delayed for a period of time equal to 25% of the system standby battery capacity to eliminate spurious reports as a result of power fluctuations.
  - 5. Record within system history, the occurrence of the event, the time of occurrence and the device initiating the event.
  - 6. Transmit the trouble signal information to the Network Command Center system with the system ID/Location and the signal information.

## **PART 2 - PRODUCTS**

### **2.1 MAIN FIRE ALARM CONTROL PANEL**

- A. Main FACP is existing.

### **2.2 LOCAL CONTROL PANEL:**

- A. The control panel shall be modular in construction and shall include, but not limited to; the hardware, software and firmware required to perform the following major system functions:
1. Steel, satin black, baked enamel cabinet with indicator viewing window, removable hinged outer door with cylinder lock and dead front construction with the outer door open. The inner dead front doors shall be hinged for ease of system operation by firefighters and access by technicians for testing and maintenance modes.
  2. System power supplies, including necessary transformers rectifiers, regulators, filters and surge protection required for system operation, with the capacity to power the system in a worst case condition with all devices in alarm and all local indicating appliances active without exceeding the listed ratings. All system devices shall display normal and alarm conditions consistently whether operating from normal power or reserve (standby) power.
  3. Surge protection shall be supplied at the power input to each cabinet. The surge suppression shall be of the phase to neutral (normal mode suppression). Phase to ground devices, MOV based devices and pure inductive devices shall not be considered acceptable. Protection shall also be furnished for SLC and NAC circuits where exiting and entering any structure, connected prior to any system devices within the structure.
  4. System 16 bit core processor, with internal operating system to process incoming alarm signals and issue output commands required as a result of the alarm reception, by system programming or by manual commands. Total system response time shall not exceed 10 seconds on a system configured to the 2000 input address maximum capacity. All system processors shall be supervised by individual watchdog circuitry furnishing automatic restart after loss of activity. Systems with a single watchdog circuits for all processors shall not be acceptable unless supplied with a "hot" standby CPU.
  5. Digital communication capabilities supporting communications using either DC digital or fiber optics technologies or combinations of both as required for the control panel to communicate with up to 63 local network nodes, including annunciators, and remote alphanumeric panels displaying local network information.
  6. Capability shall exist within the system to extend the network at any node to the systems maximum capacity.
  7. Provide interface module with this system to communicate with the Network Command Center (NCC) communicating with other XLS Series. The network module shall allow for interaction of all panels connected to the network.
  8. Selective historical log, up to 800 events of all types, shall be stored in flash memory and displayed, printed or downloaded by classification for selective event reports.
    - a. The system shall allow selection of events to be logged, including inputs, as; alarm, trouble, supervisory, security, status changes, walk tests and device verification, outputs as; audible control and output activation, actions as; reset, set sensitivity, arm/disarm, override, password, set time and acknowledge.



- b. Data format for downloading shall be adaptable to a data base management program allowing custom report generation to track alarms, troubles and maintenance.
    - c. Audible and visual indications shall be generated when memory is 80% and 90% full to allow downloading of data.
9. Card Cage modules shall be provided as the system bus, furnishing systems intra-cabinet communications to the various modules required for system operation and expansion.
  - a. The Card Cage modules shall have the spacing for 4 card slots for ½ cards.
10. System display/keyboard shall be usable at any network node and shall have the following capabilities, capacities, indicators and controls:
  - a. An 80-character back lighted alphanumeric super twist LCD display readable at any angle.
  - b. Thirty-two character user defined custom messages shall describe the location of the active device.
  - c. Display shall indicate desired message in a sequence, including; English/Spanish, English/Portugese, English/French and English. Either of the selected languages shall be selectable as the primary display.
  - d. The system shall be capable of programming to allow troubles occurring and restored in the system to be automatically removed from the display queue.
  - e. Touch activated, audible feed-back, membrane switch functions, programmable to perform a minimum of twelve custom designed and programmed functions such as drill, disable, bypass automatic control commands or other special functions as required by the system user.
  - f. The membrane switches shall also be used for the entry of multiple key sequences to be used for pass code protection inputs into logic strings, preventing un-authorized command entry.
11. The system shall support a minimum of three supervised remote alphanumeric annunciators as full function remote control points. Each supervised annunciator shall support printers, video display terminals, color video display terminals, CRT's and connected slave annunciators as indicated on the drawings.
12. Each system display shall be programmable, as a software function at the Fire Alarm Control Panel to be full function or display only, with its own set of function commands, as described above. Selection in software shall also determine the display of either local only or global information.
13. The system shall have capabilities allowing vectored reporting of Alarms, Supervisory, Security, Troubles and Status, to dedicated alphanumeric radio pagers. The information displayed on the pager shall identify the system, the device address, state of the device and the alphanumeric description of the device location. The system shall have capabilities of up to eight classifications of remote reports. The system specified shall be model 4100ES.

### 2.3 POWER SUPPLY

- A. System power supply, including necessary transformers rectifiers, regulators, filters and surge protection required for system operation, with the capacity to power the system in a worst case condition with all devices in alarm and all local indicating appliances active without exceeding the listed ratings. All system devices shall display normal and alarm conditions consistently whether operating from normal power or reserve (standby) power.
- B. Surge protection shall be supplied at the power input to each cabinet. The surge suppression shall be of the phase to neutral (normal mode suppression). Phase to ground devices, MOV based devices and pure inductive devices shall not be considered acceptable. Protection shall also be furnished for SLC and NAC circuits where exiting and entering any structure, connected prior to any system devices within the structure.
- C. Standby power source shall meet the requirements for standby capacity as detailed in NFPA 72, i.e. supervisory for 24 hours and sufficient power to provide the required discharge, control and notification.
- D. Transfer from AC to battery power shall be instantaneous when AC voltage drops to appoint where it is not sufficient for normal operation.
- E. Transfer to battery standby shall be indicated by display and recorded in the history file with time and date. Indication shall be "AC OFF". During battery operation, system shall process all inputs. However, LCD display shall provide five (5) seconds of backlighting for each new input condition, and then turn off LCD back light to conserve battery power. System charger shall provide recharge of batteries to full capacity in 48 hours.
- F. Supply a 12-amp power supply model 4100-5125.

### 2.4 SYSTEM ENCLOSURES:

- A. Provide the enclosure needed to hold all the cards and modules as specified with at least spare capacity for two cards. The enclosures shall be either black or red. Provide the color as to the local AHJ requirements. The outer doors shall be capable of being a left hand open or a right hand open. The inner door shall have a left hand opening. System enclosure doors shall provide where required ventilation for the modules or cards in the enclosure.

### 2.5 NETWORK COMMAND CENTER

- A. Computer with 21" touch screen monitor and listed software to monitor and control up to 31 nodes.

### 2.6 SYSTEM PRINTERS:

- A. The Network Command Center printer shall be operated from the printer port of the NCC and shall be "UL" listed with the system. This parallel printer shall be supervised for: On/Off line, out of paper, paper jam, power off, and connection the system. The printer shall be a; high

speed, wide carriage, and capable of using tractor or friction fed paper. Supervised network connection shall be either as required by local requirements. The printer shall contain diagnostic LED's for ease in maintenance.

- B. The remote annunciator shall be either a system display as indicated on the drawings. The remote annunciator shall have all the capabilities of the system annunciator. The remote annunciator shall have the ability to be programmed as an annunciator only or an annunciator with full system control. The module shall be model 4603-9101.

## **2.7 INITIATION DEVICES INTELLIGENT**

- A. System intelligent alarm initiation devices shall be furnished and installed where indicated on the drawings.

- 1. Detectors not listed for sensitivity testing from the control panel shall not be deemed acceptable due to the additional maintenance expense involved in the required removal, calibrated smoke generation and testing as described by N.F.P.A. 72.
- 2. Sensitivity testing performed from the control panel shall be logged by the system printer or stored in system memory as specified, as a permanent record of the performance of code mandated testing.
- 3. Detectors shall be operational with addressable relay bases, addressable audible bases and remote indicating LED's, programmable by the control panel and controlled by the detector electronics. They shall be supplied and installed with one of these options where indicated on the drawings or required by the operational requirements of this specification.
- 4. Detector shall be readily disassembled without the requirement for special tools to gain access to the detection chamber for cleaning and maintenance.
- 5. Detectors shall be assigned a sensitivity level for alarm threshold by the central controller, if not programmed to respond to a specific fire occupancy profile, based on environment, time of day or other programmable functions as required by the system user and shall respond at that level whether in the on line mode or default mode.

- B. Fire Detectors, application Specific

- 1. Detectors shall be listed for use as open area protective coverage, in duct installation and sampling assembly installation and shall be insensitive to air velocity changes.
- 2. Low profile, white case shall not exceed 2.5 inches of extension below the finish ceiling.
- 3. The detector shall be designed to eliminate calibration errors associated with field cleaning of the chamber.
- 4. Detectors shall be programmable as application specific, selected in software for a minimum of eleven specific environmental fire profiles unique to the installed location. These fire profiles shall eliminate the possibility of false indications caused by dust, moisture, RFI/EMI, chemical fumes and air movement while factoring fire burn rates, ambient temperature rise, obscuration rate changes and hot/cold smoke phenomenon into the alarm decision to give the earliest possible real alarm condition report.
- 5. Detectors shall be capable of reporting a pre-alarm condition, indicating a potential emergency situation, when reaching a value appropriate to the occupancy in which it is installed.

6. Detector electronics shall utilize surface mounted techniques and be conformal coated with a substance rendering the electronics impervious to stray conduction caused by dust and moisture. The coating shall remain stable to 135 degrees F.
  7. Detector shall be listed for duct smoke sampling when mounted in a compatible housing and shall be specifically programmable as a duct smoke detector in the software database. When used as a duct detector it shall support the use of a remote test switch and LED indicator. Provide model 4098-9756.
- C. Detector bases shall be low profile twist lock type with screw clamp terminals and self-wiping contacts. Bases shall be installed on an industry standard, 4" square or octagonal electrical outlet box. Bases shall be supplied with the following features as required for performance to this specification. Select the following bases as required for design operation;
1. Standard detector base model 4098-9792.
  2. The duct detector shall be capable of multi colored LED remote indicator light.
  3. The detector shall be supplied with the appropriate sampling tubes to fit the duct being monitored.
- D. The manual pull station shall be addressable and semi flush mounted. Where surface mounted is required supply the manufacturers surface mount box. Supply either of the following;
1. A single action pull station model 4099-9021.

## **2.8 NOTIFICATION APPLIANCES**

- A. The Horn or horn/strobe appliance as indicated on the drawings shall be a synchronized temporal horn with a synchronized strobe light with multiple candela taps to meet the intended application. The appliance shall be red or white as indicated on the drawings. The strobe light taps shall be adjustable for 15/75, 30/75, 75, and 110 candela. The appliance shall be red for wall mounted and white for ceiling mounted. Ceiling mounted appliances shall be rated for that application. The model number shall be 59AV series.
- B. The strobe only appliance as indicated on the drawings shall be a synchronized strobe light with multiple candela taps to meet the intended application. The strobe light taps shall be adjustable for 15/75, 30/75, 75, and 110 candela. The appliance shall be red for wall mounting and white for ceiling mounted. Ceiling mounted appliances shall be rated for that application. The model number shall be 4906 series.
- C. An alarm extender panel shall be provided where needed. The power supply shall be a minimum of 6 amps. The power supply shall contain four supervised notification circuits maximum of 3 amps each circuit. The power supply shall contain built-in synchronizing modules for strobes and audibles. There shall be a 3 amp filtered auxiliary power limited output. There shall be a minimum of 8 options as to the operations of the inputs and outputs. The model shall be 4100-5125.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION:**

- A. Perform work in accordance with the requirements of NFPA 70, NFPA 72.
- B. Fasten equipment to structural members of building or metal supports attached to structure, or to concrete surfaces.
- C. In the event that limited energy cable installation is allowed under Div. 26, all cable runs shall be run at right angles to building walls, supported from structure at intervals not exceeding 3 feet and where installed in environmental air plenums, be rated for such use and tied/supported by components listed for environmental air plenums installation.

#### **3.2 BOXES, ENCLOSURES AND WIRING DEVICES:**

- A. Boxes shall be installed plumb and firmly in position.
- B. Extension rings with blank covers shall be installed on junction boxes where required.
- C. Junction boxes served by concealed conduit shall be flush mounted.
- D. Upon initial installation, all wiring outlets, junction, pull and outlet boxes shall have dust covers installed. Dust covers shall not be removed until wiring installation when permanent dust covers or devices are installed.

#### **3.3 CONDUCTORS:**

- A. Each conductor shall be identified as shown on the drawings at each with wire markers at terminal points. Attach permanent wire markers within 2 inches of the wire termination. Marker legends shall be visible.
- B. All wiring shall be supplied and installed in compliance with the requirements of the National Electric Code, NFPA 70, Article 760, and that of the manufacturer.
- C. Wiring for strobe and audible circuits shall be a minimum 14 AWG, signal line circuits; 18 AWG twisted shielded.
- D. All splices shall be made using solderless connectors. All connectors shall be installed in conformance with the manufacturer recommendations.
- E. Crimp-on type spade lugs shall be used for terminations of stranded conductors to binder screw or stud type terminals. Spade lugs shall have upset legs and insulation sleeves sized for the conductors.
- F. Permanently label or mark each conductor at both ends with permanent alphanumeric wire markers.

- G. A consistent color code for fire alarm system conductors throughout the installation.
- H. The installation contractor shall submit for approval prior to installation of wire, a proposed color code for system conductors to allow rapid identification of circuit types.
- I. Wiring within sub panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.

**3.4 DEVICES:**

- A. Relays and other devices to be mounted in auxiliary panels are to be securely fastened to avoid false indications and failures due to shock or vibration.
- B. Wiring within panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.
- C. All devices and appliances shall be mounted to or in an approved electrical box.

**3.5 CERTIFICATE OF COMPLIANCE:**

- A. Complete and submit to the Project Engineer in accordance with NFPA 72, most current edition adopted by the Authority Having Jurisdiction.

**3.6 FIELD QUALITY CONTROL:**

- A. Testing, general
  - 1. Wiring runs shall be tested for continuity, short circuits and grounds before system is energized. Resistance, current and voltage readings shall be made as work progresses.
  - 2. The acceptance inspector shall be notified before the start of the required tests. All items found at variance with the drawings or this specification during testing or inspection by the acceptance inspector shall be corrected.
  - 3. Test reports shall be delivered to the acceptance inspector as completed.
  - 4. All test equipment, the installing contractor shall make instruments, tools and labor required to conduct the system tests available. The following equipment shall be a minimum for conducting the tests:
    - a. Ladders and scaffolds as required to access all installed equipment.
    - b. Multi-meter for reading voltage, current and resistance.
    - c. A manufacturer recommended device for measuring airflow through air duct smoke detector sampling assemblies.
    - d. In addition to the testing specified to be performed by the installing contractor, the installation shall be subject to test by the acceptance inspector.

### **3.7 ACCEPTANCE TESTING:**

- A. A written acceptance test procedure (ATP) for testing the fire alarm system components and installation will be prepared by the engineer in accordance with NFPA 72 and this specification. The contractor shall be responsible for the performance of the ATP, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and programming.
- B. A program matrix shall be prepared by the installing contractor referencing each alarm input to every output function affected as a result of an alarm condition on that input.
- C. The installing contractor prior to the ATP shall prepare a complete listing of all device labels for alphanumeric annunciator displays.
- D. The acceptance inspector shall use the system record drawings in combination with the documents specified in this specification during the testing procedure to verify operation as programmed. In conducting the ATP, the acceptance inspector shall request demonstration of any or all input and output functions. The items tested shall include but not be limited to the following:
  - 1. System wiring shall be tested to demonstrate correct system response and correct subsequent system operation in the event of:
    - a. Open, shorted and grounded signal line circuits.
    - b. Open, shorted and grounded notification, releasing circuits.
    - c. Primary power or battery disconnected.
  - 2. System notification appliances shall be demonstrated as follows:
    - a. All alarm notification appliances actuate as programmed
    - b. Audibility and visibility at required levels.
  - 3. System indications shall be demonstrated as follows:
    - a. Correct message display for each alarm input at the control display.
    - b. Correct annunciator light for each alarm input at each annunciator and graphic display as shown on the drawings.
    - c. Correct history logging for all system activity.
  - 4. System off-site reporting functions shall be demonstrated as follows:
    - a. Correct zone transmitted for each alarm input
    - b. Trouble signals received for disconnect
  - 5. Secondary power capabilities shall be demonstrated as follows:
    - a. System primary power shall be disconnected for a period of time as specified herein. At the end of that period, an alarm condition shall be created and the system shall perform as specified for a period as specified.

- b. System primary power shall be restored for forty-eight hours and system-charging current shall be normal trickle charge for a fully charged battery bank.
- c. System battery voltages and charging currents shall be checked at the fire alarm control panel.

### **3.8 DOCUMENTATION:**

- A. System documentation shall be furnished to the owner and shall include but not be limited to the following:
  - 1. System record drawings and wiring details including one set of reproducible drawings, and a CD ROM with copies of the record drawings in DXF format for use in a CAD drafting program.
  - 2. System operation, installation and maintenance manuals.

### **3.9 SERVICES:**

- A. The contractor shall warrant the entire system against mechanical and electrical defects for a period described in the contract general conditions. This period shall begin upon completed certification and test of the system or upon first beneficial use of the system, whichever is earlier.
- B. The fire alarm system subcontractor or manufacturer shall offer for the owner's consideration at the time of system submittal a priced inspection, maintenance, testing and repair contract in full compliance with the requirements of NFPA 72.
- C. The owner shall have the option of renewing at the price quoted for single or multiple years up to five years.
- D. The contractor performing the contract services shall be qualified and listed to maintain ongoing certification of the completed system to the UL for specific installed system listing.
- E. The installation contractor shall furnish training as follows for a minimum of four employees of the system user:
  - 1. Training in the receipt, handling and acknowledgment of alarms.
  - 2. Training in the system operation including manual control of output functions from the system control panel.
  - 3. The total training requirement shall be a minimum of 2 hours, but shall be sufficient to cover all items specified.

**END OF SECTION 28 31 11**



## **SECTION 31 20 00 – EARTH MOVING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes the following:
1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns and grasses
  2. Excavating and backfilling for buildings and structures.
  3. Drainage course for slabs-on-grade.
  4. Base course for concrete walks and pavements.
  5. Excavating and backfilling for utility trenches.

#### **1.2 QUALITY ASSURANCE**

- A. Standard Specifications: Comply with the Standard Specifications for Public Works Construction (SSPWC), latest edition and supplements for rock materials. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the Work. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

#### **1.3 REFERENCES**

- A. This specification section has been prepared using the project soils report “Geotechnical Investigation Report Building MM – Construction Trades Phase II Long Beach City College – Pacific Coast Campus 1305 E Pacific Coast Highway Long Beach, California”, by TWINING Inc. dates March 5, 2020 as a reference.

#### **1.4 DEFINITIONS**

- A. Backfill: Soil material used to fill an excavation.
1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
  2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Course placed between the subgrade and hot-mix asphalt or concrete paving.
- C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Classified Excavation: Removal and disposal of materials not defined as rock

- F. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- G. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
  - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions changes in the Work.
  - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- H. Fill: Soil materials used to raise existing grades.
- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base, drainage fill, or topsoil materials.
- K. Unclassified Excavation: Removal and disposal of materials encountered regardless of nature of materials, including rock.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

## 1.5 PROJECT CONDITIONS

- A. Examine site, Drawings, records of existing utilities and construction, record of test borings, and subsurface exploration report available from Owner. Records of test borings are for information only and are not guaranteed to represent all conditions that will be encountered.

## 1.6 PROTECTION

- A. Soils Consultant: A geotechnical consultant shall advise on Construction techniques involved in work, including design, checking and approving of temporary bracing, sheeting, shoring, underpinning and other items pertinent to work, and encountered during prosecution of work. Consultant shall be primarily concerned with construction methods, which will prevent settlement or damage to surrounding structures, sidewalks, embankments, utilities and roads on Owner's property and adjoining properties.

B. Existing Utilities:

1. Maintain existing utilities that are to remain in service. Before excavating over or adjacent to existing utilities, notify utility Owner to ensure protective work will be coordinated and performed in accordance with utility Owner's requirements. If existing service lines, utilities and utility structures, which are to remain in service, are uncovered or encountered during these operations, safeguard and protect from damage.
2. Within limits of excavation, remove existing piping, subsoil drainage systems, conduit, manholes and relocated items, which are to be abandoned. Plug open ends of utilities to remain with concrete.
3. Re-route existing subsoil drains which obstruct work around new constructions, or incorporate them into new drainage systems.
4. Consult Architect immediately for directions, should uncharted or incorrectly charted piping or other utilities be encountered during excavation. Cooperate with Owner and public and private utility companies in keeping their respective services, utilities and facilities in operation. If damaged, repair utilities to satisfaction of Architect and utility Owner.

C. Existing Facilities: Protect and maintain in satisfactory manner, existing pavements, curbs, gutters, structures, conduits, fences, walls and other facilities to remain above and below grade. Restore facilities damaged by construction operations.

D. Pumping and Draining: Excavate areas in such manner as to afford adequate drainage. Control grading in vicinity of excavated areas so ground surface will slope to prevent water running into excavated areas. Until work is completed, remove water from areas of construction that may interfere with proper performance of work or that may result in damage to the soil sub-grade and provide sumps, pumps, well points, electric power and attendance required for this purpose on a 24 hour basis if necessary. Protect construction from water during construction, including prevention of erosion of completed work during construction and until permanent drainage and erosion controls are operational. Repair adjoining properties, facilities and streets damaged due to improper protection.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Sand, gravel, friable earth, or non-expansive clays, subject to Testing Laboratory's approval. Fill and backfill material shall be free of organic material, slag, cinders, expansive soils, trash or rubble and stones having maximum dimension greater than 40% larger than ¾ inch.
- C. Unsatisfactory Soils: Expansive and other soils as defined in the project's geotechnical investigation report.

1. Unsatisfactory soils also include satisfactory soils not maintained within two percent of optimum moisture content at time of compaction.
- D. Base Course: Material conforming to SSPWC section 200-2.2, Crushed Aggregate Base or SSPWC section 200-2.4 Crushed Miscellaneous Base.
- E. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a one and one-half-inch sieve and not more than 12 percent passing a No. 200 sieve.
- F. Bedding Course: Crushed rock conforming to SSPWC Section 200.1-2 and Table 306-1.2.1.3 (B).
- G. Drainage Course: Narrowly graded mixture of washed, crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a one and one-half-inch sieve and zero to five percent passing a No. 8 sieve.

## 2.2 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, six inches wide and four mils thick, continuously inscribed with a description of the utility. Color coding shall be according to the American Public Works Association (APWA) standards:
  1. Blue – Potable water and fire suppression lines.
  2. Green – Sanitary sewer and storm drain lines
  3. Orange – Communication, alarm or signal lines
  4. Purple – Reclaimed water, irrigation, and slurry lines
  5. Red – Electrical power lines, cables, conduit and lighting lines
  6. Yellow – Gas, oil, steam, petroleum, or gaseous material lines.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 2 Section "Site Clearing" or "Demolition".
- C. Protect and maintain erosion and sedimentation controls, which are specified in Division 2 Section "Site Clearing" or "Demolition," during earthwork operations.

### **3.2 EXCAVATION**

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
  - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

### **3.3 EXCAVATION FOR STRUCTURES**

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus one inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
  - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

### **3.4 EXCAVATION FOR WALKS AND PAVEMENTS**

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

### **3.5 EXCAVATION FOR UTILITY TRENCHES**

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Excavate trenches to uniform widths to provide six-inch clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
  - 1. Excavate trenches six inches deeper than elevation required in rock or other unyielding bearing material, four inches deeper elsewhere, to allow for bedding course.

### **3.6 SUBGRADE INSPECTION**

- A. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

- B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

### **3.7 UNAUTHORIZED EXCAVATION**

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2,500 pounds per square inch (psi), may be used when approved by Architect.
  - 1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

### **3.8 STORAGE OF SOIL MATERIALS**

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

### **3.9 UTILITY TRENCH BACKFILL**

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 3 Section Cast-in-Place Concrete.
- D. Place and compact initial backfill of satisfactory soil, free of particles larger than one inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
  - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- E. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- F. Install warning tape directly above utilities, minimum six inches above top of pipe, minimum 12 inches below finished grade, except six inches below subgrade under pavements and slabs.

### **3.10 SOIL FILL**

- A. Plow, scarify, bench, or break up sloped surfaces steeper than one vertical to four horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
  - 1. Under grass and planted areas, use satisfactory soil material.
  - 2. Under walks and pavements, use engineered fill.
  - 3. Under steps and ramps, use engineered fill.
  - 4. Under building slabs, use engineered fill.
  - 5. Under footings and foundations, use engineered fill.

### **3.11 SOIL MOISTURE CONTROL**

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within two percent of optimum moisture content.
  - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
  - 2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by two percent and is too wet to compact to specified dry unit weight.

### **3.12 COMPACTION OF SOIL BACKFILLS AND FILLS**

- A. Place backfill and fill soil materials in layers not more than eight to ten inches in loose depth for material compacted by heavy compaction equipment, and not more than four inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
  - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top six inches of existing subgrade and each layer of backfill or fill soil material to 90 percent.
  - 2. Under walkways, scarify and recompact top six inches below subgrade and compact each layer of backfill or fill soil material to 90 percent.
  - 3. Under lawn or unpaved areas, scarify and recompact top six inches below subgrade and compact each layer of backfill or fill soil material to 90 percent.
  - 4. For utility trenches, compact each layer of initial and final backfill soil material to 90 percent.

### 3.13 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
  - 1. Lawn or Unpaved Areas: Plus or minus one inch.
  - 2. Walks: Plus or minus one inch.
  - 3. Pavements: Plus or minus one-half inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of one-half inch when tested with a 10-foot straightedge.

### 3.14 BASE COURSES

- A. Place base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place base course under pavements and walks as follows:
  - 1. Shape base course to required crown elevations and cross-slope grades.
  - 2. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 90 percent of maximum dry unit weight according to ASTM D 1557.

### 3.15 DRAINAGE COURSE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
  - 1. Place drainage course that exceeds six inches in compacted thickness in layers of equal thickness, with no compacted layer more than six inches thick or less than three inches thick.
  - 2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

### 3.16 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.



- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

### **3.17 PROTECTION**

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
  - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

### **3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS**

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

**END OF SECTION 31 20 00**

## **SECTION 32 08 00 - COMMISSIONING OF EXTERIOR IMPROVEMENTS**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION**

- A. Commissioning: Commissioning is a systematic process of ensuring that all building systems perform interactively according to the owner's project requirements and operational needs. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing adjusting and balancing, performance testing and training. Commissioning during the construction phase is intended to achieve the following specific objectives:
1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
  2. Verify and document proper functional performance of equipment and systems.
  3. Verify that O&M documentation left on site is complete.
  4. Verify that the Owner's operating personnel are adequately trained.
- B. Facility Grid: The CxA utilizes Facility Grid, cloud-based and mobile commissioning software platform to execute commissioning activities and deliverables. <https://facilitygrid.com/> CxA will provide project team members introduction to Facility Grid's platform. Facility Grid will allow CxA, facility managers, architects, contractors, maintenance personnel, and corporate administrators can actually see and operate in the same loop real time. This transparency opens the door to major short and long-term efficiencies in all phases of the facilities management process. Facility Grid defines the future of commissioning software by increasing the efficiency of commissioning agents, by streamlining commissioning projects and record keeping, by enabling project managers to see the big and small pictures in real time, across all projects, and by providing owners with a database of building information to benefit from today and in the future.
1. Real-Time Collaboration
  2. Transparency
  3. Team Engagement
  4. Accountability
  5. Information Sustainability

#### **1.2 RELATED WORK**

- A. Division 01 - General Requirements
1. Section 01 33 00 - Submittal Procedures
  2. Section 01 77 00 - Closeout Procedures
  3. Section 01 91 13 - General Commissioning Requirements

### **1.3 ABBREVIATIONS AND DEFINITIONS**

- A. A/E: Design Professional
- B. ASI: Architectural Supplemental Instruction
- C. BAS: Building Automation System
- D. BoD: Basis of Design. A narrative of how the designer plans to achieve the OPR.
- E. CxA: Commissioning Authority
- F. CC: Controls Contractor
- G. CM: Construction Manager
- H. Cx: Commissioning
- I. Cx Plan: Commissioning Plan
- J. Cx RFI: Commissioning Request for Information
- K. DDC: Direct Digital Control System
- L. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents and cannot be corrected in five (5) minutes time.
- M. EC: Electrical Contractor
- N. FBO: Furnished By Others
- O. FT: Functional Performance Test
- P. GC: General Contractor
- Q. IAW: In Accordance With
- R. MC: Mechanical Contractor
- S. O&M: Operation and Maintenance
- T. OPM: Owner Project Manager
- U. OPR: Owner Project Requirement. A dynamic document expressing how the owner expects the building systems to perform upon project completion.
- V. PC: Prefunctional Checklist
- W. RFI: Request for Information
- X. Sub(s): Subcontractors or Prime Contractor

- Y. TAB: Test, Adjust and Balance
- Z. TBD: To Be Determined

#### **1.4 EXTERIOR IMPROVEMENTS EQUIPMENT AND SYSTEMS TO BE COMMISSIONED**

- A. The specific systems that shall be commissioned include:
  - 1. Landscape Irrigation Systems (and all integral equipment controls)
    - a. Landscape Irrigation System (8 zones)

#### **1.5 SUBMITTALS**

- A. Refer also to Specification Section 01 91 13, Subsection 1.6.
- B. Provide the CxA a copy of the following items, for the systems to be commissioned:
  - 1. Equipment and System Submittals to include, at minimum, the following:
    - a. Equipment Data Sheets
    - b. Performance data
    - c. Manufacturer's pre-startup checklists
    - d. Manufacturer's start-up checklists
    - e. Installation Instructions
  - 2. Shop drawings (including any resubmittals required by the A/E)
  - 3. Piping - Supply one copy of all of hydrostatic pressure test results
  - 4. Operational and maintenance documentation
  - 5. Training plan and training materials
  - 6. As-built documentation

### **PART 2 - PRODUCTS**

#### **2.1 TEST EQUIPMENT**

- A. Refer to Specification Section 01 91 13, Subsection 2.1.

### **PART 3 - EXECUTION**

#### **3.1 MEETINGS**

- A. Refer to Specification Section 01 91 13, Subsection 3.3.

### 3.2 START-UP, PREFUNCTIONAL CHECKLISTS, AND INITIAL CHECKOUT

- A. The following procedures apply to all equipment to be commissioned, according to Subsection 1.4 above.
- B. General: Prefunctional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
- C. Start-up and Initial Checkout Plan
  - 1. The CxA will provide prefunctional checklists (PFCs). PFCs indicate the required procedures to be executed as part of startup and initial checkout of the systems.
  - 2. The subcontractor responsible for providing and installing the equipment develops the full start-up plan by combining (or adding to) the CxA's prefunctional checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
  - 3. The full start-up plan shall consist of:
    - a. The CxA's prefunctional checklists.
    - b. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end
    - c. The manufacturer's normally used field checkout sheets
  - 4. The contractor submits the full startup plan to the CxA for review and approval. The CxA reviews and approves the procedures and the format for documenting them, noting any plans that need to be added.
- D. Execution of Prefunctional Checklists and Startup
  - 1. Two weeks prior to startup, the Subs and vendors schedule startup and checkout with the CM, GC and CxA. The performance of the prefunctional checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off prefunctional checklists, signatures may be required of other Subs for verification of completion of their work.
  - 2. The CxA will observe the physical start-up of all major systems.
  - 3. The CxA will verify piping cleanout procedures and verify any required water or lab tests.
  - 4. The Subs and vendors shall execute startup and provide the GC with a signed and dated copy of the completed start-up and prefunctional tests and checklists. The GC reviews for completion and accuracy, then submits to the CxA.
  - 5. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.
  - 6. Completed startup test report must be provided to CxA prior to functional testing.
- E. Deficiencies, Non-Conformance and Approval in Checklists and Startup

1. The Subs shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully. The procedures form and any outstanding deficiencies shall be provided to the CxA within two days of test completion.
2. The CxA will work with the Subs and vendors to determine what is required to correct outstanding deficiencies and retest deficiencies of uncompleted items. The CxA will involve the CM, GC and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CxA as soon as outstanding items have been corrected.
3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in back charges to the responsible party. Refer to Specification Section 01 91 13, Subsection 3.6 - DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS.

### **3.3 FUNCTIONAL PERFORMANCE TESTING**

- A. This subsection applies to functional testing and demonstration for equipment and system in this division.
- B. The general list of equipment and systems to be commissioned is found in Subsection 1.4.
- C. Objectives and Scope
  1. The objective of functional performance testing is to demonstrate that each system is operating according to the owner's project requirements, documented project program, and Contract Documents. Functional testing facilitates bringing the systems from a state of material completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and function of the systems.
  2. In general, each system shall be operated through all modes of operation where there is a specified system response.
  3. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.
  4. The contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, tools, instruments, ladders, lifts, computers, software, cables, etc. Contractor supplied personnel must be competent with and knowledgeable of all project-specific systems, and automation hardware and software. All training documentation, submittals, installation manuals, and O&Ms, shall be at the job site before functional testing commences.
- D. Development of Test Procedures
  1. The CxA develops specific functional test procedures and forms to verify and document proper operation of each piece of equipment and system. The CxA provides a copy of the test procedures to the A/E, CM and installing Sub who shall review the tests prior to testing. The A/E and Sub(s) shall point out to the CxA any specific problems as related to feasibility, safety, equipment and warranty protection.
- E. Coordination and Scheduling
  1. The GC shall provide sufficient notice to the CxA regarding the Subs completion schedule for the prefunctional checklists and startup of all equipment and systems. The CxA will schedule functional tests after written notification from the GC and affected Subs. Completed startup testing report must be provided to CxA prior to functional testing. The CxA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.

2. In general, functional testing shall not be scheduled until all hardware and software submittals are approved, Prefunctional checklists are approved, and start-up has been satisfactorily completed. Scheduling of functional testing shall be done with a minimum of two weeks' notice prior to testing. Functional testing of the equipment and systems listed in Subsection 1.04 of this specification section shall not be conducted out of the presence of the CxA and CM, unless specifically approved to do so in writing by the CxA or CM. Any functional testing which occurs outside the presence of the CxA or CM without written authorization to do so will be required to be re-tested at no expense to the owner.

F. Test Methods

1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone data loggers.

G. Demonstration, Verification, and Validation: The exterior improvement systems demonstration shall include, at minimum, the following:

1. Landscape Irrigation System (8 zones)
2. Irrigation Control System
  - a. Demonstrate that all functions of the irrigation system meet the specified requirements. The CxA will validate a minimum of 50% of devices.

H. Problem Solving

1. The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the GC, Subs and A/E.

### **3.4 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS**

- A. Refer to Specification Section 01 91 13, Subsection 3.06.

### **3.5 OPERATION AND MAINTENANCE MANUALS**

- A. In addition to installation manuals, the contractor shall provide one copy of the Operation and Maintenance Manuals to the CxA for the systems to be commissioned. The O&M Manuals shall be provided to the CxA at least 8 weeks prior to the start of Functional Testing.

### **3.6 TRAINING OF OWNER PERSONNEL**

- A. See Specification Section 01 91 13, Subsection 3.8.
- B. Provide designated Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of plumbing equipment or system.
- C. CxA shall attend a sample of the training sessions and validate that the training has occurred according to the specifications.

**3.7 DEFERRED TESTING**

- A. See Specification Section 01 91 13, Subsection 3.9.



**APPENDIX A**

**EXAMPLE PREFUNCTIONAL CHECKLIST**

**System Name:** Landscape Irrigation

**Serves:** Site

**Prefunctional Checklist**

1. Verification: Pre-functional checklist items must be completed as part of startup & initial checkout, in preparation for Functional Performance Testing. The following items are complete and the system is ready for Functional Performance Testing:
  - a. Items that do not apply shall be noted with the reasons on this form (N/A = not applicable).
    - 1) The prefunctional checklist items are complete and have been signed off only by parties having direct knowledge of the event.
      - a) Contractor's assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.

"Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item.

This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items.

The installation is complete and ready for functional testing.

A/E	Architect/Engineer	All	All contractors	EC	Electrical Contractor
CxA	Commissioning Agent	CC	Controls (BAS) Contractor	GC	General Contractor
LC	Landscape Contractor	TAB	TAB Contractor	PC	Plumbing Contractor

<u>Signature:</u>	<u>Signature:</u>	<u>Signature:</u>
<u>Date:</u>	<u>Date:</u>	<u>Date:</u>
<u>Name:</u>	<u>Name:</u>	<u>Name:</u>
GC: General Contractor Company	LC: Landscape Contractor Company	PC: Plumbing Contractor Company

<u>Signature:</u>	<u>Signature:</u>	<u>Signature:</u>
<u>Date:</u>	<u>Date:</u>	<u>Date:</u>
<u>Name:</u>	<u>Name:</u>	<u>Name:</u>
Owner: Owner Representative Company	CC: Controls Contractor Company	

**2. Approvals**

This prefunctional checklist has been completed and is approved with the exceptions noted below.

Signature:  
Date:

Name: \_\_\_\_\_  
CxA: Commissioning Authority Company

**3. Equipment Verification**

Enter N/A if not applicable. Enter note or # if deficient. Attach notes to this sheet.

Equipment Specifications	As Specified	As Submitted	As Installed	Notes
Manufacturer	Rainbird	Carrier		
Model Number	Hunter Pro-C	Hunter Pro-C		
Serial Number	N/A	N/A		
Electrical (Volts/Phase/Hz)	120/1/60	120/1/60		

**4. Installation Checks**

Enter N/A if not applicable. Enter note or # if deficient. Attach notes to this sheet.

General Installation	Contractor	Check or Note or #
Unit is free of physical damage	LC	
Permanent identification (labels) affixed and visible	LC	
Unit installed as required by manufacturer and construction documents	LC	
Access acceptable for future maintenance of unit and components	LC	
Unit casing condition good (no dents, no leaks and gaskets installed)	LC	
Access doors close tightly (no leaks)	LC	
Installed indoors or within a protected enclosure	LC	
Unit is clean, free of debris	LC	
Valves, Piping and Coils	Contractor	Check or Note or #
Piping components installed in correct order as required by drawing details	LC	
Piping installed and arranged for ease of unit and components maintenance	LC	
Piping is flushed, free of debris and air	LC	
Permanent identification (labels) affixed and visible	LC	
Electrical Installation	Contractor	Check or Note or #
All electrical connections are tight and code compliant	EC	
All electrical connections are grounded per drawings	EC	
Local disconnect switch is operational	EC	
Breaker/disconnect(s) labeled as to the circuit and equipment served	EC	
Overloads and/or fuses installed, sized and calibrated correctly	EC	
120 Volt power connection for lights and/or convenience outlets install	EC	

**5. Operational Checks**

Enter N/A if not applicable. Enter note or # if deficient. Attach notes to this sheet.

<b>Irrigation System</b>	<b>Contractor</b>	<b>Check or Note or #</b>
Drip system evening dispensing water across zones	LC	
Irrigation heads evening dispensing water across zones	LC	
After 24-hours operation, inspect alignment. Adjust as necessary.	LC	
Manufacturer's startup checklist completed and attached (if applicable)	LC / EC	
<b>Irrigation Controls</b>	<b>Contractor</b>	<b>Check or Note or #</b>
Applicable watering schedule set (e.g. establishment or established)	LC	
Each respective zone watering duration set	LC	
Seasonal adjustment automatically schedule or linked to weather station	LC	

**6. Notes:**

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\*Attach additional sheets if needed.  
-- END OF CHECKLIST --

**APPENDIX B**  
**EXAMPLE FUNCTIONAL TEST PROCEDURE**  
**Functional Performance Test**

**7. System Description**

This landscape irrigation system energizes different irrigating zones based upon the controller's programmed time schedule established by the landscape architect to operate in establishment and established modes. In establishment mode, the irrigation controller energizes allowing each of the irrigation zones to cycle through their run cycle more often to allow the plantings to take root. In established mode, the irrigation controller energizes allowing each of the irrigation zones to cycle through their run cycle to maintain the plantings health. The irrigation controller is equipment of a weather station enabling the irrigation system controller to not operate the irrigation system during rain or high soil moisture content.

- a. **Building:** Building x
  - 1) **System:** Landscape Irrigation Controller
    - a) **Equipment Identification:**  
LI-x

**Make:** Rainbird  
**Model:** \_\_\_\_\_  
**Serial:** \_\_\_\_\_

**Equipment Location:** Utility Closet xxx  
**Serves:** Utility Closet xxx

**8. Test Participants**

Organization		Participation Capacity
General Contractor	General Contractor Company	Provide assistance as needed for corrective items. Verify that items are completed, keep track of schedule.
Landscape Contractor	Landscape Contractor Company	Provide testing support and NIST certified instrumentation for checks outlined herein.
Owner's O&M Personnel	Owner Representative Company	<i>Optional</i>
Commissioning Authority	Commissioning Authority Company	Along with the controls contractor, perform the functional performance testing as Independent third party witness and documenting functional performance results.

**9. Approvals**

We the undersigned participated in this functional test, acknowledge that the functional testing process for the equipment has been completed and that noted deficiencies or corrective actions noted have been made.

<i>Signature:</i>	<i>Signature:</i>	<i>Signature:</i>
<i>Date:</i>	<i>Date:</i>	<i>Date:</i>
<i>Name:</i>	<i>Name:</i>	<i>Name:</i>

GC: General Contractor Company <i>Signature:</i>	PC: Landscape Contractor Company <i>Signature:</i>	EC: Electrical Contractor Company <i>Signature:</i>
Date:	Date:	Date:
<i>Name:</i>	<i>Name:</i>	<i>Name:</i>
Owner: Owner Rep. Company	CxA: Commissioning Authority Co.	

**10. Test Prerequisites**

General Contractor to verify following items have been completed and system is ready for functional testing:

- a. Site checks of the prefunctional checklist and manufacturer startup reports completed successfully.
  - 1) A/E deficiency items for this equipment are completed
    - a) Functional Performance Test procedures have been reviewed and approved by installing contractors

Safety controls and operating ranges are set, activated and checked

Initial Test		Start Date	End Date	Initials
Results (check one) <input type="checkbox"/> ? Pass <input type="checkbox"/> ? Fail <input type="checkbox"/> ? Partial Test w/ Corrective Actions <input type="checkbox"/> ? Complete Test w/ Corrective Actions <input type="checkbox"/> ? Other	Explanation:			
Re-Test 1		Start Date	End Date	Initials
Results (check one) <input type="checkbox"/> ? Pass <input type="checkbox"/> ? Fail <input type="checkbox"/> ? Partial Test w/ Corrective Actions <input type="checkbox"/> ? Complete Test w/ Corrective Actions <input type="checkbox"/> ? Other	Explanation:			
Re-Test 2		Start Date	End Date	Initials
Results (check one) <input type="checkbox"/> ? Pass <input type="checkbox"/> ? Fail	Explanation:			

<input type="checkbox"/> Partial Test w/ Corrective Actions <input type="checkbox"/> Complete Test w/ Corrective Actions <input type="checkbox"/> Other	
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**11. Establishment Operation Schedule**

- Irrigation controller can be assigned to schedule
- Irrigation controller current date and time programmed

	AM											PM												
Day	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11
Sun																								
Mon																								
Tues																								
Wed																								
Thurs																								
Fri																								
Sat																								
Holi																								

**12. Established Operation Schedule**

- Irrigation controller can be assigned to schedule
- Irrigation controller current date and time programmed

	AM											PM												
Day	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11
Sun																								
Mon																								
Tues																								
Wed																								
Thurs																								
Fri																								
Sat																								
Holi																								

**13. Setpoint Verification**

Record setpoint

Point Description	Setpoint		Note #
	Design	Actual	
Zone Run Cycle Duration	10 minutes		
Seasonal Adjust			

**14. Functional Testing Procedures**

The Commissioning Authority will make and document any changes, additions or deletions to this test procedure required by current system conditions (i.e. weather, system load, utility availability, etc.)

**Y** = Checked and Passed

**R** = Retest (check if retest required)

**N** = Not Passed

**C** = Corrected (check if correction verified)

**15. Notes:**

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\*Attach additional sheets if needed.

Note: Items of non-compliance to the test requirements will be noted on the Master Commissioning Deficiency Log. The deficiency log will contain information such as date found, equipment/system involved, potential cause, responsibility and potential remedial actions. The contractor/supplier is expected to use their collective expertise to solve the problem(s) or replace defective equipment.

-- END OF TEST -

**END OF SECTION 32 08 00**

## SECTION 32 13 13 – CONCRETE PAVING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes exterior cement concrete pavement for the following:
  - 1. Curbs and gutters.
  - 2. Walkways.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated, including admixtures.
- B. Design Mixtures: For each concrete pavement mixture.

#### 1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.
- C. All work to be performed and materials to be used shall be in accordance with the Standard Specifications for Public Works Construction, latest edition and supplements.
- D. The Contractor shall have one copy of the Standard Specifications at the job site.
- E. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the Work. The legal/contractual relationship sections and the measurement and pavement sections do not apply to this document.

### PART 2 - PRODUCTS

#### 2.1 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.



- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice."

## 2.2 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project:
  - 1. Portland Cement: ASTM C 150, Type II, low alkali. Supplement with the following:
    - a. Pozzolan: ASTM C618, Class F or N Fly Ash, 100 pounds maximum per cubic yard, containing one percent or less carbon. Fly ash shall not be used in excess of 15 percent by weight of total cement quantity.
- B. Combined Aggregates: Gradation "C" conforming to SSPWC Section 201-1.3.2.
- C. Water: ASTM C 94/C 94M.

## 2.3 CURING MATERIALS

- A. Liquid Curing Compound: ASTM C309, fugitive dye dissipating type, complying with Rule II 13 of the South Coast Air Quality Management District and Federal Air Quality Regulation 40 CFR 52.254.
- B. Moisture-Retaining Cover (Curing Sheet): ASTM C 171, non-staining polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

## 2.4 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
- C. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

- D. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with Caltrans Standard Specifications - Section 84 (Federal Specification No. TT-P-1952 for Blue, Red and Green paint; and State of California Standard Specification No. PTWB-01 for White, Yellow and Black paint) with drying time of less than 45 minutes.
1. Color: As indicated

## **2.5 CONCRETE MIXTURES**

- A. Prepare design mixtures, proportioned according to ACI 301, with the following properties:
1. Compressive Strength (28 Days): 2,500 pounds per square inch (psi)
  2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.60.
  3. Slump Limit: Four inches, plus or minus one inch.
- B. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions.

## **2.6 CONCRETE MIXING**

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates to Architect for each batch discharged and used in the Work.

# **PART 3 - EXECUTION**

## **3.1 EXAMINATION**

- A. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

## **3.2 EDGE FORMS AND SCREED CONSTRUCTION**

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

### 3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

### 3.4 JOINTS

- A. General: Form construction, isolation, and control joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
- D. Control Joints: Form weakened-plane control joints, sectioning concrete into areas as indicated. Within 24 hours of pour, construct control joints for a depth equal to at least one-fourth of the concrete thickness to match jointing of existing adjacent concrete pavement.
- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a one-fourth-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

### 3.5 CONCRETE PLACEMENT

- A. Moisten subbase to provide a uniform dampened condition at time concrete is placed.
- B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- D. Screed pavement surfaces with a straightedge and strike off.
- E. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

### 3.6 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.

- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
  2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
  3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface one-sixteenth to one-eighth inch deep with a stiff-bristled broom, perpendicular to line of traffic.
- C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on pavement surface according to manufacturer's written instructions.
1. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
  2. After curing, lightly work surface with a steel wire brush or abrasive stone and water to expose nonslip aggregate.

### **3.7 CONCRETE PROTECTION AND CURING**

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 pounds/square feet x h before and during finishing operations. Apply according to manufacturers written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these methods.

### **3.8 PAVEMENT TOLERANCES**

- A. Comply with tolerances as follows

1. Elevation: One-fourth inch.
2. Thickness: Plus three-eighths inch minus one-fourth inch.
3. Surface: Gap below 10-foot long, unlevelled straightedge not to exceed one-fourth inch.
4. Joint Spacing: Three inches.
5. Contraction Joint Depth: Plus one-fourth inch no minus.
6. Joint Width: Plus one-eighth inch, no minus.

### **3.9 PAVEMENT MARKING**

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow concrete pavement to cure for 28 days and be dry before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

### **3.10 REPAIRS AND PROTECTION**

- A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.
- B. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement.
- C. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

**END OF SECTION 32 13 13**

## SECTION 32 13 13.16 - CONCRETE PAVING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Concrete paving, bands, curbs, mow strips, steps and walls.
2. Reinforcement.
3. Surface finish.
4. Special curing.

B. Related sections:

1. Section 31 20 00 - Earth Moving, for backfilling and compacted fill for paving.
2. Section 32 13 73 - Joint Sealants, for paving contraction joint sealing.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: Provide a 4 x 4 foot job site sample of each paving finish specified, for review and approval by District's Representative prior to installation. Sample shall represent final appearance of paving, including any stain, sealer or other surface applications. Provide additional samples until finish is considered acceptable by the District's Representative, at no additional cost to the District. The approved sample shall serve as a standard of appearance for the final work to be produced and shall remain on site until all site concrete has been reviewed and approved by the District's Representative.

C. Other Action Submittals:

1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

#### 1.3 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. ACI Publications: Comply with ACI 301 unless otherwise indicated.

## 1.4 TESTS

- A. Testing and analysis will be performed under provisions of Section 014000 - Quality Requirements.
- B. Make available proposed mix design of each class of concrete to appointed firm for review prior to commencement of work.
- C. Testing firm will take cylinders and perform slump and air entrainment tests in accordance with ACI 301.
- D. Tests of cement and aggregates will be performed to ensure conformance with specified requirements.
- E. Three concrete test cylinders will be taken for every 75 or less cubic yards of each class of concrete placed each day.
- F. One additional test cylinder will be taken and be cured on site under same conditions as concrete it represents.
- G. One slump test will be taken for each set of test cylinders taken.

## PART 2 - PRODUCTS

### 2.1 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
  - 1. Cement: ASTM C 150 Normal-Type I, gray Portland cement.
  - 2. Blended Hydraulic Cement: ASTM C 595, cement.
- B. Normal-Weight Aggregates: ASTM C 33, Class 4S, uniformly graded. Provide aggregates from a single source.
- C. Water: Clean, potable and complying with ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
- F. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
  - 1. Color: As indicated.

## 2.2 FORM MATERIALS

- A. Conform to ACI 301.
- B. Wood or Steel form material, profiled to suit conditions.

## 2.3 STEEL REINFORCEMENT

- A. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, uncoated finish, fabricated from as-drawn steel wire into flat sheets.
- C. Reinforcing Bars: ASTM A 615/A 615M; deformed, uncoated finish.
- D. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.
- E. Tie Wire: Annealed steel, minimum 16 gage size.
- F. Dowel Bars: ASTM A 615/A 615M, plain-steel bars. Cut bars true to length with ends square and free of burrs, uncoated finish.
- G. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's Manual of Standard Practice from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified.

## 2.4 FIBER REINFORCEMENT

- A. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in concrete paving, complying with ASTM C 1116/C 1116M, Type III, 1/2 inch long.

## 2.5 ACCESSORIES

- A. Pre-emergent Herbicide: Surflan.
- B. Curing Compound: FS TT-C-800, Type 1, 30 percent solids; ASTM C309, Ashford Formula.
- C. Integral Color (Non-immersion Conditions): L.M. Scofield Chromix, or approved equal.
- D. Chemical Surface Retarder: 'Top-cast' by Grace Construction Products.
- E. Liquid Surface Sealer: 'HLQ-125' by SINAK Corporation.
- F. Patch Bond: Weld-Crete.



## 2.6 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.

## 2.7 PAVEMENT MARKINGS

- A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than 45 minutes.
  - 1. Color: As indicated.
- B. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.
  - 1. Color: As indicated.

## 2.8 WHEEL STOPS

- A. Wheel Stops: Precast, air-entrained concrete.
  - 1. Color: Gray.
  - 2. Dowels: Galvanized steel, 3/4 inch in diameter, 10-inch minimum length.
  - 3. Adhesive: As recommended by wheel stop manufacturer for application to concrete pavement.

## 2.9 CONCRETE MIXTURES

- A. Mix concrete in accordance with ASTM C94.
- B. Prepare design mixtures, proportioned according to ACI 301, with the following properties:
  - 1. Compressive Strength (28 Days): 3000 psi.
  - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50.
  - 3. Slump Limit: 4 inches, plus or minus 1 inch.
  - 4. Air Content: 6 percent plus or minus 1.5 percent.
- C. Chemical Admixtures:
  - 1. Use accelerating admixtures in cold weather only when approved by District's Representative. Use of admixtures will not relax cold weather placement requirements.
  - 2. Use set-retarding admixtures during hot weather only when approved by District's Representative.
- D. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 pound/cu. yd.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions.

- F. Add air entraining agent to concrete mix for concrete work as necessary.

## **2.10 CONCRETE MIXING**

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION AND PREPARATION**

- A. Verify compacted subgrade and/or base is ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.
- C. Beginning of installation means acceptance of existing conditions.
- D. Moisten base to minimize absorption of water from fresh concrete.
- E. Notify District's Representative minimum 24 hours prior to commencement of concreting operations.
- F. Proof-roll prepared sub-base surface below concrete paving to identify soft pockets and areas of excess yielding.
- G. Remove loose material from compacted sub-base surface immediately before placing concrete.

### **3.2 EDGE FORMS AND SCREED CONSTRUCTION**

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement. Obtain layout approval prior to pour.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete. Use of permanent concrete screed is permissible. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.
- C. Place joint fillers vertical in position, in straight lines. Secure to formwork during concrete placement.

### **3.3 REINFORCEMENT**

- A. Place reinforcement. Comply with CRSI's Manual of Standard Practice for fabricating, placing, and supporting reinforcement.
- B. Interrupt reinforcement at expansion joints.

- C. Place reinforcement to achieve slab and curb alignment as detailed.
- D. Provide dowelled joints at interruptions of concrete with one end of dowel set in capped sleeve to allow longitudinal movement.

### 3.4 JOINTS

- A. General: Form construction, isolation, and expansion joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct control joints at maximum 5 foot intervals of paving and at right angles to centerline unless otherwise indicated. Align curb, gutter and sidewalk joints when possible.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
- D. Expansion Joints: Place expansion joints at 20 foot intervals unless otherwise shown to correct elevation and profile. Place expansion joints between paving components and building or other appurtenances.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/8-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

### 3.5 CONCRETE PLACEMENT

- A. Comply with ACI 301 requirements for measuring, mixing, transporting, placing, and consolidating concrete.
- B. Ensure reinforcement, inserts, embedded parts and formed joints are not disturbed during concrete placement.
- C. Deposit and spread concrete in a continuous operation between predetermined construction joints. Do not push or drag concrete into place or use vibrators to move concrete into place. Do not break or interrupt successive pours such that cold joints occur.
- D. Place concrete to pattern indicated.
- E. Coordinate pours of integral color concrete to ensure consistency of color throughout. Color inconsistency will not be accepted.
- F. For steps, walls or other cast-in-place elements, settle concrete by vibration to eliminate honeycombs. Concrete with visible honeycombs will be rejected.
- G. Screed paving surface with a straightedge and strike off.

- H. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- I. Tolerances in horizontal alignment of hardscape elements such as paving edges, joints, walls and steps shall not exceed 1/4 inch in 10 feet, or 1/2 inch in 50 feet.

### 3.6 FINISHING

- A. See plan for finishes and finish locations.
- B. Curbs, mow strips and gutters: Light broom, unless otherwise specified.
- C. Finishes:
  - 1. General: Do not add water to concrete surfaces during finishing operations. Compact and tamp concrete (unless Retardant Finish is specified), to bring 3/8 inch of mortar to surface, float with wood screeds and floats only, and apply following finishes after surface floating. Do not use steel or any plastic screeds, floats or "Fresno" for initial floating and screeding operations. For Retardant Finish, the concrete shall be placed and consolidated so as to completely fill all spaces in the forms; however, tamping will not be permitted because the aggregate must remain near the surface for later exposure.
  - 2. All concrete finishes shall be as listed on the Drawings. Finishes are as follows:
    - a. Fine-to-Medium-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
    - b. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.
    - c. Rough Trowel Swirl Finish: Provide rough trowel finish to slab surfaces. After placing slabs, consolidate surface by floating to a uniform, smooth, granular texture.
    - d. Scratch Finish: Provide scratch finish to slab surfaces that are to receive mortar setting beds for precast tile pavers as noted on Drawings.
    - e. Steel Trowel Finish: After surface water disappears and floated surface is sufficiently hardened, steel trowel and re-trowel to smooth, dense, hard finish. After concrete has set sufficiently, re-trowel to a smooth, uniform finish free of trowel marks or other blemishes. Avoid excessive troweling that produces burned areas.
    - f. Sandblast Finish (Dry Sand Method):
      - 1) Contractor shall schedule this work to be executed with as little conflict with other trades as possible. Contractor shall be responsible for the protection or masking of adjacent surfaces, if necessary.
      - 2) Test areas for sample of blasting will be established where surfaces will not be left exposed. District's Representative shall be present at time of sample blasting and approve the desired finish.
      - 3) Care shall be taken to protect all adjacent surfaces from damage which are not receiving sandblasting.

- 4) Sandblasting shall be accomplished using qualified workmen familiar with the proper technique.
  - 5) Sandblasting work shall be by the dry sane method, utilizing appropriate equipment and adequate air pressure. Abrasives shall be washed silica sand free from salt, clay or other foreign materials. Nozzle position during the operation shall be as determined in the making of the approved samples.
  - 6) All concrete areas requiring patching shall be patched, with all rough spots and unevenness in the concrete surface ground smooth before the sandblasting operation is begun.
- g. Etched or Retardant Finish (with Surface Retarder):
- 1) All work shall conform to applicable OSHA and EPA standards.
  - 2) Contractor shall schedule this work to be executed with as little conflict with other trades as possible. If necessary, Contractor shall be responsible for the protection of adjacent masonry and concrete surfaces with a film-forming protective coating, 'Face-off' by Grace Construction Products, or approved equal, allowing time for coating to dry prior to pouring concrete.
  - 3) Preparatory Work: The concrete should be placed and consolidated so as to completely fill all spaces in the forms. Tamping will not be permitted for Top-cast finish #25 or higher because the aggregate must remain near the surface for later exposure.
  - 4) Application of Retarder: Surface retarder shall be applied by qualified workmen familiar with the proper technique. After concrete has been floated or trowel finished and initial bleed water has risen to the surface, apply film-forming top surface retarder, 'Top-cast' by Grace Construction Products or approved equal, at specified gradient, using a low-pressure sprayer with a 0.5 gpm tip at a rate of 200-350 square feet per gallon until surface has a complete hiding coat. Once surface retarder has cured adequately, dependent on weather and site conditions, remove by pressure washing. Remove rinse water and cement matrix from site in accordance with local codes.

### 3.7 CONCRETE PROTECTION, CURING AND SEALING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 pound/square feet x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture-retaining-cover curing, curing compound or a combination of these.

- F. Concrete Surface Sealer: All concrete paving shall be sealed with a clear, penetrating concrete sealer. If efflorescence or alkali-staining is evident after the concrete has cured, lightly wash the surface with a mild muriatic acid solution (usually a 10:1 dilution) that has been thoroughly rinsed with water and cleaned with diluted Lithochrome Floor Cleaner by L.M. Scofield, or approved equal. Rinse again and dry thoroughly. After concrete mix has cured for at least one month, the concrete surface shall be thoroughly washed with fresh, clean water. After surface is thoroughly dried, apply 'HLQ-125' as manufactured by SINAK Corporation, or approved equal, per manufacturer's specifications.

### **3.8 PAVING TOLERANCES**

- A. Comply with tolerances in ACI 117 and as follows:
1. Elevation: 3/4 inch.
  2. Thickness: Plus 3/8 inch, minus 1/4 inch.
  3. Surface: Gap below 10-foot- long, unlevelled straightedge not to exceed 1/2 inch.
  4. Joint Spacing: 3 inches.
  5. Contraction Joint Depth: Plus 1/4 inch, no minus.
  6. Joint Width: Plus 1/8 inch, no minus.

### **3.9 PAVEMENT MARKING**

- A. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.
- B. Sweep and clean surface to eliminate loose material and dust.
- C. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 millimeters.

### **3.10 WHEEL STOPS**

- A. Install wheel stops in bed of adhesive applied as recommended by manufacturer.
- B. Securely attach wheel stops to paving with not less than two steel dowels located at one-quarter to one-third points. Install dowels in drilled holes in the paving and bond dowels to wheel stop. Recess head of dowel beneath top of wheel stop.

### **3.11 REPAIRS AND PROTECTION**

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by District's Representative.

- B. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- C. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

**END OF SECTION 32 13 13.16**

## **SECTION 32 13 73 – CONCRETE PAVEMENT JOINT SEALANTS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes the following:
  - 1. Expansion and isolation joints within cement concrete pavement.

#### **1.2 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Compatibility and Adhesion Test Reports: From sealant manufacturer.

#### **1.3 QUALITY ASSURANCE**

- A. Preconstruction Compatibility and Adhesion Testing: Submit samples of materials that will contact or affect joint sealants to joint-sealant manufacturers for testing according to 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.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

#### **2.2 MATERIALS, GENERAL**

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.
  - 1. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.



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

### 2.3 COLD-APPLIED JOINT SEALANTS

- A. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.

1. Products:

- a. Crafcro Inc.; RoadSaver Silicone.
- b. Dow Corning Corporation; 888.
- c. Or any equivalent product.

- B. Type SL Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.

1. Products:

- a. Crafcro Inc.; RoadSaver Silicone SL.
- b. Dow Corning Corporation; 890-SL.
- c. Or any equivalent product.

### 2.4 HOT-APPLIED JOINT SEALANTS

- A. Elastomeric Sealant for Concrete: Single-component formulation complying with ASTM D 3406.

1. Products:

- a. Crafcro Inc.; Superseal 444/777.
- b. Meadows, W. R., Inc.; Poly-Jet 3406.
- c. Or any equivalent product.

### 2.5 JOINT-SEALANT BACKER MATERIALS

- A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

- B. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

- C. Backer Strips for Cold-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Concrete curing requirement: The concrete must be allowed to cure and dry a minimum of seven days in good drying weather before installing sealant. An additional day of good drying weather must be allowed for each day of poor, inclement weather.
- B. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
- C. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience.
- D. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- E. Install backer materials to support sealants during application and at position required to produce optimum sealant movement capability. Do not leave gaps between ends of backer materials. Do not stretch, twist, puncture, or tear backer materials. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.
- F. Install sealants at the same time backings are installed to completely fill recesses provided for each joint configuration and to produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
- H. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

**END OF SECTION 32 13 73**

## **SECTION 32 13 73.16 - CONCRETE PAVING JOINT SEALANTS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
1. Cold-applied joint sealants.
  2. Hot-applied joint sealants.

#### **1.2 PRECONSTRUCTION TESTING**

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, eight samples of materials that will contact or affect joint sealants. Use 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.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each kind and color of joint sealant required.
- C. Pavement-Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
  2. Joint-sealant manufacturer and product name.
  3. Joint-sealant formulation.
  4. Joint-sealant color.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Product certificates.
- B. Product test reports.
- C. Preconstruction compatibility and adhesion test reports.

#### **1.5 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021.

- B. Preinstallation Conference: Conduct conference at project site.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As indicated by manufacturer's designations.

### 2.2 COLD-APPLIED JOINT SEALANTS

- A. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.
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. Crafco Inc., an ERGON company; RoadSaver Silicone.
    - b. Dow Corning Corporation; 888.
    - c. Pecora Corporation; 301 NS.
- B. Single-Component, Self-Leveling, Silicone Joint Sealant for Concrete: ASTM D 5893, Type SL.
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. Crafco Inc., an ERGON company; RoadSaver Silicone SL.
    - b. Dow Corning Corporation; 890-SL.
    - c. Pecora Corporation; 300 SL.
- C. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.
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. Pecora Corporation; Urexpam NR-200.

### 2.3 HOT-APPLIED JOINT SEALANTS

- A. Hot-Applied, Single-Component Joint Sealant for Concrete: ASTM D 3406.
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. Crafco Inc., an ERGON company; Superseal 444/777.

- B. Hot-Applied, Single-Component Joint Sealant for Concrete and Asphalt: ASTM D 6690, Types I, II, and III.
  - 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. Meadows, W. R., Inc.; Sealtight Hi-Spec.
    - b. Right Pointe; D-3405 Hot Applied Sealant.

## 2.4 JOINT-SEALANT BACKER MATERIALS

- A. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- B. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
- C. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

## 2.5 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Cleaning of Joints: Clean out joints immediately before installing joint sealants.
- C. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- D. Install joint-sealant backings of kind indicated to support joint 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 joint-sealant backings.
  - 2. Do not stretch, twist, puncture, or tear joint-sealant backings.

3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place joint sealants so they directly contact and fully wet joint substrates.
  2. Completely fill recesses in each joint configuration.
  3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
1. Remove excess joint sealant from surfaces adjacent to joints.
  2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- G. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.
- H. Clean off excess joint sealant or sealant smears adjacent to joints as the Work progresses, by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

**END OF SECTION 32 13 73.16**

## SECTION 323113 - CHAIN LINK FENCES AND GATES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Chain-link fences.
  - 2. Swing gates.
  - 3. Privacy slats.

#### 1.2 PREINSTALLATION MEETINGS

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

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of fence and gate assembly.
  - 1. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Delegated-Design Submittal: For structural performance of chain-link fence and gate frameworks, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Product test reports.
- C. Sample warranty.

#### 1.5 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of chain-link fences and gates 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. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design chain-link fence and gate frameworks.
- B. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to ASCE/SEI 7.
  - 1. Design Wind Load: As indicated on Drawings.
    - a. Minimum Post Size: Determine according to ASTM F 1043 for post spacing not to exceed 10 feet (3 m) for Material Group IA, ASTM F 1043, Schedule 40 steel pipe.
    - b. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified.

### 2.2 CHAIN-LINK FENCE FABRIC

- A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:
  - 1. Fabric Height: As indicated on Drawings.
  - 2. Steel Wire for Fabric: Wire diameter of 0.113 inch minimum.
    - a. Mesh Size: 2 inches (50 mm).
    - b. Polymer-Coated Fabric: ASTM F 668, Class 1 over zinc-coated steel wire.
      - 1) Color: As selected by Architect from manufacturer's full range, according to ASTM F 934.
    - c. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.
  - 3. Selvage: Knuckled at both selvages.

### 2.3 FENCE FRAMEWORK

- A. Posts and Rails: ASTM F 1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 or ASTM F 1083 based on the following:
  - 1. Fence Height: As indicated on Drawings.
  - 2. Light-Industrial-Strength Material: [Group IC-L, round steel pipe, electric-resistance-welded pipe].
    - a. Line Post: 2.375 inches (60 mm) in diameter minimum.
    - b. End, Corner, and Pull Posts: 2.875 inches (73 mm) minimum.
    - c. Hinge/Jamb, 4.0 inches outside diameter minimum
    - d. Gate Frame, 1.875 inches minimum
  - 3. Horizontal Framework Members: Intermediate top and bottom rails according to ASTM F 1043.
  - 4. Brace Rails: ASTM F 1043.
  - 5. Metallic Coating for Steel Framework:
    - a. Type A zinc coating.



- b. Type B zinc with organic overcoat.
- c. External, Type B zinc with organic overcoat and internal, Type D zinc-pigmented coating.
- d. Type C, Zn-5-Al-MM alloy coating.
- e. Coatings: Any coating above.
6. Polymer coating over metallic coating.
  - a. Color: As selected by Architect from manufacturer's full range, according to ASTM F 934.

## 2.4 TENSION WIRE

- A. Metallic-Coated Steel Wire: 0.177-inch- (4.5-mm-) diameter, marcelled tension wire according to ASTM A 817 or ASTM A 824, with the following metallic coating:
  1. Type I: Aluminum coated (aluminized).
  2. Type II: Zinc coated (galvanized) with minimum coating weight matching chain-link fabric coating weight.
  3. Type III: Zn-5-Al-MM alloy with the following minimum coating weight matching chain-link fabric coating weight.
- B. Polymer-Coated Steel Wire: 0.177-inch- (4.5-mm-) diameter, tension wire according to ASTM F 1664, Class 1 over zinc-coated steel wire.
  1. Color: As selected by Architect from manufacturer's full range, according to ASTM F 934.

## 2.5 SWING GATES

- A. General: ASTM F 900 for gate posts and single or double swing gate types.
  1. Gate Leaf Width: As indicated.
  2. Framework Member Sizes and Strength: Based on gate fabric height as indicated.
- B. Pipe and Tubing:
  1. Zinc-Coated Steel: ASTM F 1043 and ASTM F 1083; protective coating and finish to match fence framework.
  2. Aluminum: ASTM B 429/B 429M; manufacturer's standard finish.
  3. Gate Posts: Round tubular steel.
  4. Gate Frames and Bracing: Round tubular steel.
- C. Frame Corner Construction: Welded or assembled with corner fittings.
- D. Extended Gate Posts and Frame Members: Fabricate gate posts and frame end members to extend as indicated above top of chain-link fabric at both ends of gate frame to attach barbed wire assemblies.
- E. Hardware:
  1. Hinges: 180-degree inward swing.
  2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
  3. Lock: Manufacturer's standard internal device.

4. Closer: Manufacturer's standard.

## 2.6 FITTINGS

- A. Provide fittings according to ASTM F 626.
- B. Finish:
  1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. (366 g/sq. m) of zinc.
    - a. Polymer coating over metallic coating.
  2. Aluminum: Mill finish.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

### 3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet (152 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

### 3.3 CHAIN-LINK FENCE INSTALLATION

- A. Install chain-link fencing according to ASTM F 567 and more stringent requirements specified.
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
  1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
  2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
    - a. Exposed Concrete: Extend 2 inches (50 mm) above grade; shape and smooth to shed water.
    - b. Concealed Concrete: Place top of concrete 2 inches (50 mm) below grade to allow covering with surface material.
    - c. Posts Set into Sleeves in Concrete: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement,

mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.

- d. Posts Set into Holes in Concrete: Form or core drill holes not less than 5 inches (127 mm) deep and 3/4 inch (20 mm) larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.
  - D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment as indicated on Drawings. For runs exceeding 500 feet (152 m), space pull posts an equal distance between corner or end posts.
  - E. Line Posts: Space line posts uniformly at 96 inches (2440 mm) o.c.
  - F. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- (3.05-mm-) diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches (610 mm) o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:
    - 1. Extended along top and bottom of fence fabric.
    - 2. As indicated on Drawings.
  - G. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2-inch (50-mm) bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- 3.4 ADJUSTING
- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
  - B. Lubricate hardware and other moving parts.

END OF SECTION 323113

## **SECTION 32 31 19 - DECORATIVE METAL FENCES AND GATES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

A. Section Includes:

1. Decorative steel fences.
2. Swing gates.
3. Gate operators, including controls.

B. Related Sections:

1. Division 1 Section "Sustainable Design Requirements" for additional LEED requirements.

#### **1.2 ACTION SUBMITTALS**

A. Product Data: For each type of product indicated.

B. Shop Drawings: For gates. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Samples: For each fence material and for each color specified.

D. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

#### **1.3 CLOSEOUT SUBMITTALS**

A. Maintenance Data: For gate operators to include in maintenance manuals.

#### **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. UL Standard: Provide gate operators that comply with UL 325.

- C. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators on gates that must provide emergency access.

## **PART 2 - PRODUCTS**

### **2.1 STEEL AND IRON**

- A. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Bars (Pickets): Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.
- C. Tubing: ASTM A 500, cold formed steel tubing.
- D. Bar Grating: NAAMM MBG 531.
  - 1. Bars: Hot-rolled steel strip, ASTM A 1011/A 1011M, Commercial Steel, Type B.
  - 2. Wire Rods: ASTM A 510.
- E. Uncoated Steel Sheet: Hot-rolled steel sheet, ASTM A 1011/A 1011M, Structural Steel, Grade 45.
- F. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 50, with G90 coating.
- G. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, structural quality, Grade 50, with AZ60 coating.
- H. Recycled Content:
  - 1. Steel produced by electric arc furnace (EAF): Recycled content not less than 90 percent.
  - 2. Steel produced by basic oxygen furnace (BOF): Recycled content not less than 25 percent.

### **2.2 COATING MATERIALS**

- A. Epoxy Zinc-Rich Primer for Steel: Complying with MPI #20 and compatible with coating specified to be applied over it.
- B. Epoxy Primer for Galvanized Steel: Complying with MPI #101 and compatible with coating specified to be applied over it.
- C. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.
- D. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.

### 2.3 MISCELLANEOUS MATERIALS

- A. Concrete: Normal-weight concrete complying with requirements in Section 033000 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 3000 psi, 3-inch slump, and 1-inch maximum aggregate size.
- B. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107 and specifically recommended by manufacturer for exterior applications.

### 2.4 GROUNDING MATERIALS

- A. Grounding Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
  - 1. Material above Finished Grade: Copper.
  - 2. Material on or below Finished Grade: Copper.
- B. Grounding Connectors and Grounding Rods: Comply with UL 467.

### 2.5 DECORATIVE STEEL FENCES

- A. Decorative Steel Fences: Fences made from steel tubing and shapes.
  - 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 & T Iron Works, Inc.
    - b. Ametco Manufacturing Corporation.
    - c. BarnettBates Corporation.
    - d. Golden State.
- B. Posts: Square steel tubing, with 1/8-inch wall thickness.
- C. Post Caps: Formed from steel sheet.
- D. Rails:
  - 1. Steel Tube Rails: Square steel tubing with 1/8-inch wall thickness.
- E. Pickets: Decorative steel bars of pattern and size indicated.
  - 1. Picket Spacing: 4 inches clear, maximum.
- F. Fasteners: Stainless-steel carriage bolts and tamperproof nuts.
- G. Fabrication:

1. Fit and shop assemble in largest practical sections, for delivery to site.
  2. Fabricate items with joints tightly fitted and secured.
  3. Continuously seal joined members by continuous welds.
  4. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
  5. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
  6. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- H. Galvanizing: Hot-dip galvanize to comply with ASTM A 123/A 123M.
1. Hot-dip galvanize posts and rails.
  2. Hot-dip galvanize rail and picket assemblies after fabrication.
- I. Finish for Steel Items: Primed with two coats and shop-painted.

## 2.6 SWING GATES

- A. Galvanized-Steel Frames and Bracing: Fabricate members from square tubes formed from 0.108-inch nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch nominal-thickness steel sheet and hot-dip galvanized after fabrication.
- B. Steel Frames and Bracing: Fabricate members from square steel tubing with 1/8-inch wall thickness.
- C. Hardware: Latches permitting operation from both sides of gate, hinges, and keepers for each gate leaf more than 5 feet wide.
- D. Galvanizing: For items that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A 123/A 123M unless otherwise indicated.
- E. Steel Finish: Primed with two coats and shop-painted.

## 2.7 GATE OPERATORS

- A. General: Provide factory-assembled automatic operating system designed for gate size, type, weight, and operation frequency. Provide operation control system with characteristics suitable for Project conditions, with remote-control stations, safety devices, and weatherproof enclosures; coordinate electrical requirements with building electrical system.
1. Provide operator with UL-approved components.
  2. Provide controllers, electrical devices, and wiring.

- B. Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 110513 "Common Motor Requirements for 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.
- C. Gate Operators: Concrete base mounted and as follows:
  - 1. Hydraulic Swing Gate Operators:
    - a. Duty: Heavy duty, commercial/industrial.
  - 2. Mechanical Swing Gate Operators:
    - a. Duty: Heavy duty, commercial/industrial.
- D. Remote Controls: Electric controls separated from gate and motor and drive mechanism, with NEMA ICS 6, Type enclosure for concrete base mounting, and with space for additional optional equipment. Provide the following remote-control device(s):
  - 1. Card Reader: Programmable, multiple-code system.
  - 2. Digital Keypad Entry Unit: Multiple-programmable, code capability.
  - 3. Vehicle Detector: Loop system including automatic closing timer with adjustable time delay before closing, and timer cutoff switch,] designed to hold gate open until traffic clears.
- E. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately reverse gate in both opening and closing cycles and hold until clear of obstruction.

## 2.8 Accessories:

- A. Battery Backup System: Battery-powered drive and access-control system.
- B. Instructional, Safety, and Warning Labels and Signs: According to UL 325.

## 2.9 STEEL FINISHES

- A. Surface Preparation: Clean surfaces according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 1. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- B. Powder Coating: 2-coat finish consisting of epoxy primer and TGIC polyester topcoat, with a minimum total dry film thickness of not less than 8 mils.



- C. Primer Application: Apply zinc-rich epoxy primer immediately after cleaning, to provide a minimum dry film thickness of 2 mils.
- D. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Apply at spreading rates recommended by coating manufacturer.
  - 1. Match approved Samples for color, texture, and coverage.

### **PART 3 - EXECUTION**

#### **3.1 DECORATIVE FENCE INSTALLATION**

- A. Install fences according to manufacturer's written instructions.
- B. Post Excavation: Excavate holes to a diameter of not less than 4 times post size and a depth of not less than 24 inches plus 3 inches for each foot or fraction of a foot that fence height exceeds 4 feet.
- C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
  - 1. Hold posts in position during setting with concrete or mechanical devices.
  - 2. Concrete Fill: Place concrete around posts and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
  - 3. Posts Set in Concrete: Extend post to within 6 inches of specified excavation depth, but not closer than 3 inches to bottom of concrete. Crown top of concrete for positive drainage.
  - 4. Space posts uniformly at 6 feet o.c., maximum.

#### **3.2 GATE INSTALLATION**

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

#### **3.3 GATE OPERATOR INSTALLATION**

- A. General: Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.
- B. Concrete Bases: Cast-in-place or precast concrete, dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings.
- C. Vehicle Loop Detector System: Cut grooves in pavement and bury and seal wire loop according to manufacturer's written instructions. Connect to equipment operated by detector.

- D. Comply with NFPA 70 and manufacturer's written instructions for grounding of electric-powered motors, controls, and other devices.

### **3.4 GROUNDING AND BONDING**

- A. Fence Grounding: Install at maximum intervals of 1500 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. Bond metal gates to gate posts.
- B. 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 the grounding location.
- C. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
- D. 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 will be galvanically compatible.
- E. 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.

### **3.5 FIELD QUALITY CONTROL**

- A. Grounding-Resistance Testing: Engage a qualified testing agency to perform tests and inspections.

**END OF SECTION 32 31 19**

## **SECTION 32 84 00 - PLANTING IRRIGATION (RECLAIMED WATER)**

### **PART 1 - GENERAL**

#### **1.1 SECTION REQUIREMENTS**

- A. It is the intent of the specifications and drawings that the finished system is complete in every respect and shall be ready for operation satisfactory to the District.
- B. The work shall include all materials, labor, services, transportation, and equipment necessary to perform the work as in these specifications, and as necessary to complete the contract.

#### **1.2 CONSTRUCTION DRAWINGS**

- A. Due to the scale of the drawings, it is not possible to indicate all offsets, fittings, sleeves, etc. which may be required. The Contractor shall carefully investigate the structural and finished conditions affecting all of his work and plan his work accordingly, furnishing such fittings, etc. as may be required to meet such conditions. Drawings are generally diagrammatic and indicative of the work to be installed. The work shall be installed in such a manner as to avoid conflicts between irrigation systems, planting, site utilities and architectural features.
- B. All work called for on the drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications. When an item is shown on the plans but not shown on the specifications or vice versa, it shall be deemed to be as shown on both. The Landscape Architect shall have final authority for clarification. When a conflict occurs between an item shown on the plan and as shown on the specifications, the Landscape Architect shall have final authority for clarification.
- C. The Contractor shall not willfully install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in the design. Such obstructions or differences should be brought to the attention of the Landscape Architect as soon as detected. In the event this notification is not performed, the Irrigation Contractor shall assume full responsibility for any revisions necessary.

#### **1.3 QUALITY ASSURANCE**

- A. Provide at least one English speaking person who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of materials being installed and the manufacturer's recommended methods of installation and who shall direct all work performed under this section.
- B. Manufacturer's directions and detailed drawings shall be followed in all cases where the manufacturer of articles used in this contract furnishes directions covering points now shown in the drawings and specifications.

- C. All local, municipal and state laws, rules and regulations governing or relating to any portion of this work are hereby incorporated into and made a part of these specifications, and their provisions shall be carried out by the Contractor. Anything contained in these specifications shall not be construed to conflict with any of the above rules and regulations of the same. However, when these specifications and drawings call for or describe materials, workmanship, or construction of a better quality, higher standard, or larger size than is required by the above rules and regulations, the provisions of these specifications and drawings shall take precedence.
- D. All materials supplied for this project shall be new and free from any defects. All defective materials shall be replaced immediately.

#### 1.4 SUBMITTALS

A. Materials List:

- 1. After award of contract and before any irrigation system materials are delivered to the job site, submit to the Landscape Architect a complete list of all irrigation systems, materials, or processes proposed to be furnished and installed as part of this contract.
- 2. Show manufacturer's name and catalog number for each item, furnish complete catalog cuts and technical data, and furnish the manufacturer's recommendations as to the method of installation.
- 3. No substitutions will be allowed without prior written acceptance by the Landscape Architect or District's authorized representative.
- 4. Manufacturer's warranties shall not relieve the Contractor of his liability under the guarantee. Such warranties shall only supplement the guarantee.

B. Substitutions:

If the Contractor wishes to substitute any equipment or materials for those listed on the irrigation drawings and specifications, he may do so by providing the following information to the Landscape Architect for approval:

- 1. A written statement indicating the reason for making the substitution and the difference in installed price if the item is accepted.
- 2. Catalog cut sheets, technical data and performance information for each substitute item.

#### 1.5 EXISTING CONDITIONS

- A. The Contractor shall verify and be familiar with the locations, size and detail of points of connection provided as the source of water, electrical supply, and telephone line connection to the irrigation system.
- B. Irrigation design is based on the available static pressure shown on the drawings. Contractor shall verify static water on the project prior to the start of construction. Should a discrepancy exist, notify the Landscape Architect and District's authorized representative prior to beginning construction.

- C. Prior to cutting into the soil, the Contractor shall locate all cables, conduits, sewer lines, and other utilities as are commonly encountered underground and he shall take proper precautions not to damage or disturb such improvements. If a conflict exists between such obstacles and the proposed work, the Contractor shall promptly notify the Landscape Architect who will arrange for relocations. The Irrigation Contractor will proceed in the same manner if a rock layer or any other such conditions are encountered.
- D. The Contractor shall protect all existing utilities and features to remain on and adjacent to the project site during construction. Contractor shall repair, at his own cost, all damage resulting from his operations or negligence.
- E. The Irrigation Contractor shall coordinate with the General Contractor for installation of required sleeving as shown on the plans.

## **1.6 INSPECTIONS**

- A. The Landscape Architect shall be permitted to visit and inspect at all times any part of the work and shall be provided safe access for such visits.
- B. Where the specifications require work to be tested by the Contractor, it shall not be covered over until accepted by the Landscape Architect, District's authorized representative, and/or governing agencies. The Irrigation Contractor shall be solely responsible for notifying the Landscape Architect, District, and governing agencies, a minimum of 48 hours in advance, where and when the work is ready for testing. Should any work be covered without testing or acceptance, it shall be, if so ordered, uncovered at the Irrigation Contractor's expense.
- C. Inspections will be required for the following at a minimum. Landscape Architect may opt to review photographs of pressure test (with image of pressure gauge and time stamps) and sample dripline layout.
  - 1. Pressure test of irrigation main line (Three hours at 150 PSI).
  - 2. Sample layout of dripline irrigation.
  - 3. Coverage test of irrigation sprinkler system.
  - 4. Final inspection prior to start of maintenance period.
  - 5. Final acceptance.
- D. Site observations and testing will not commence without the record drawings a prepared by the Irrigation Contractor. Record drawings must be complete and up to date for each site visit.
- E. Work which fails testing and is not accepted will be retested.

## **1.7 STORAGE AND HANDLING**

- A. Use all means necessary to protect irrigation system materials before, during, and after installation and to protect the installation work and materials of all other trades. In the event of damage, immediately make all repairs and replacements necessary to the acceptance of the Landscape Architect and District.

- B. Exercise care in handling, loading, unloading, and storing plastic pipe and fittings under cover until ready to install. Transport plastic pipe only on a vehicle with a bed long enough to allow the pipe to lay flat to avoid undue bending and concentrated external load.

## 1.8 CLEANUP AND DISPOSAL

- A. Dispose of waste, trash, and debris in accordance with applicable laws and ordinances and as prescribed by authorities having jurisdiction. Bury no such waste material and debris on the site. Burning of trash and debris will not be permitted. The Contractor shall remove and dispose of rubbish and debris generated by his work and workmen at frequent intervals or when ordered to do so by the District's authorized representative.
- B. At the time of completion the entire site will be cleared of tools, equipment, rubbish and debris which shall be disposed of off-site in a legal disposal area.

## 1.9 TURNOVER ITEMS

- A. Record Drawings:
  - 1. Record accurately on one set of contract drawings all changes in the work constituting departures from the original contract drawings.
  - 2. The changes and dimensions shall be recorded in a legible and workmanlike manner to the satisfaction of the Landscape Architect. Prior to final inspection of work, submit record drawings to the Landscape Architect for review and approval.
  - 3. Dimensions from/to permanent points of reference such as buildings, sidewalks, curbs, etc. shall be shown. Data on record drawings shall be recorded on a day to day basis as the project is being installed. All lettering on drawings shall be minimum 1/8 inch in size.
  - 4. Show locations of the following items:
    - a. Point of connection (including water meters, backflow preventors, master control valves, etc.)
    - b. Routing of sprinkler pressure lines (dimensions shown at a maximum of 100 feet along routing and at all changes in direction)
    - c. Gate valves
    - d. Automatic remote control valves
    - e. Quick coupling valves
    - f. Routing of control wires
    - g. Irrigation controllers
    - h. Related equipment (as may be directed)
  - 5. Maintain record drawings on site at all times. Upon completion of work, transfer all as-built information and dimensions to a clean set of bond prints, using red, waterproof ink.
- B. Controller Charts:
  - 1. Record drawings must be approved by Landscape Architect before controller charts are prepared.

2. Provide one controller chart for each automatic controller. Chart shall show the area covered by the particular controller.
3. The chart is to be a reduced copy of the actual "record" drawing. In the event the controller sequence is not legible, when the drawing is reduced, it shall be enlarged to a readable size. Print shall be black and white, with a different color used to indicate the area of coverage for each station.
4. When completed and approved, the chart shall be hermetically sealed between two pieces of plastic, each piece being a minimum 10 millimeters in thickness, with a matte finish.

C. Operation and Maintenance Manuals:

1. Two individually bound copies of operation and maintenance manuals shall be delivered to the Landscape Architect or District's authorized representative at least 10 calendar days prior to final inspection. The manuals shall describe the material installed and the proper operation of the system.
2. Each complete, bound manual shall include the following information:
  - a. Index sheet stating Contractor's address and telephone number, duration of guarantee period, list of equipment including names and addresses of local manufacturer representatives.
  - b. Operating and maintenance instructions for all equipment.
  - c. Spare parts list and related manufacturer information for all equipment.
  - d. Guarantee Statement.

D. Equipment:

1. Supply as a part of this contract the following items:
  - a. One (1) tool for disassembly and adjustment of each type of sprinkler head used in the irrigation system.
  - b. Padlock and two (2) keys for backflow enclosure (if used).
  - c. Two keys for each automatic controller.
  - d. Two quick coupler keys with a 3/4 inch bronze hose bib, bent nose type with hand wheel and two coupler lid keys.
  - e. One valve box cover key or wrench.
  - f. One 5-foot tee wrench for operating butterfly valves (if used).
  - g. Two (2) extra sprinkler heads of each size and type.
2. The above equipment shall be turned over to District's authorized representative at the final inspection.

## 1.10 COMPLETION

- A. At the time of the pre-maintenance period inspection, the Landscape Architect, District's authorized representative, and governing agencies will inspect the work, and if not accepted, will prepare a list of items to be completed by the Contractor. At the time of the post-maintenance period or final inspection, the work will be reinspected and final acceptance will be in writing by the Landscape Architect, District's authorized representative, and governing agencies.

- B. The District's authorized representative shall have final authority on all portions of the work.
- C. After the system has been completed, the Contractor shall instruct District's authorized representative in the operation and maintenance of the irrigation system and shall furnish a complete set of operating and maintenance instructions.
- D. Any settling of trenches which may occur during the one-year period following acceptance shall be repaired. Repairs shall include the complete restoration of all damage to planting, paving or other improvements of any kind as a result of the work.

### 1.11 GUARANTEE

- A. The entire sprinkler system, including all work done under this contract, shall be unconditionally guaranteed against all defects and fault of material and workmanship, including settling of backfilled areas below grade, for a period of one (1) year following the filing of the Notice of Completion.

Should any problem with the irrigation system be discovered within the guarantee period, it shall be corrected by the Contractor at no additional expense to District within ten (10) calendar days of receipt of written notice from District. When the nature of the repairs, as determined by the District, constitutes an emergency (i.e. broken pressure line) the District may proceed to make repairs at the Contractor's expense. Any and all damages to existing improvements, resulting either from faulty materials or workmanship, shall be repaired at the Contractor's expense.

- B. Guarantee shall be submitted on Contractor's own letterhead as follows:

#### GUARANTEE FOR SPRINKLER IRRIGATION SYSTEM

We hereby guarantee that the sprinkler irrigation system we have furnished and installed is free from defects in materials and workmanship, and the work has been completed in accordance with the drawings and specifications, ordinary wear and tear and unusual abuse, or neglect excepted. We agree to repair or replace any defective material during the period of one year from date of filing of the Notice of Completion and also to repair or replace any damage resulting from the repairing or replacing of such defects at no additional cost to the District. We shall make such repairs or replacements within 10 calendar days following written notification by the District. In the event of failure to make such repairs or replacements within the time specified after receipt of written notice from District, we authorize the District to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand.

PROJECT NAME:

PROJECT LOCATION:

CONTRACTOR NAME:

ADDRESS:



TELEPHONE:

SIGNED:

DATE:

## **PART 2 - PRODUCTS**

### **2.1 SUMMARY**

Use only new materials of the manufacturer, size and type shown on the drawings and specifications. Materials or equipment installed or furnished that do not meet Landscape Architect's, District's, or governing agencies standards will be rejected and shall be removed from the site at no expense to the District.

### **2.2 PIPING**

- A. Pressure supply line from point of connection through basket strainer unit shall be Type "K" copper or brass pipe.
- B. Pressure supply lines 3 inches in diameter and larger shall be Class 200 PVC with bell-and-gasket joints. Piping shall conform to ASTM D2241.
- C. Pressure supply lines 2 inches to 2-1/2" in diameter shall be Class 315 solvent weld PVC. Piping shall conform to ASTM D1784.
- D. Pressure supply lines 1-1/2 inches and smaller in diameter shall be Schedule 40 solvent weld PVC. Piping shall conform to ASATM D1784.
- E. Non-pressure lines 3/4 inches in diameter and larger downstream of the remote control valve shall be Sch. 40 PVC or as stated on Irrigation Materials Legend on plans. Non-pressure lines 1 inch and larger to conform to ASTM D1784.
- F. Reclaimed water PVC pipe to be color coded "purple" in color and marked on two sides with reclaimed water warning statements "CAUTION – RECLAIMED WATER". Reclaimed water piping must be accepted by the local reclaimed water governing agencies.

### **2.3 METAL PIPE AND FITTINGS**

- A. Brass pipe shall be 85 percent red brass, ANSI, IPS Standard 125 pounds, Schedule 40 screwed pipe.
- B. Fittings shall be medium brass, screwed 125-pound class.
- C. Copper pipe and fittings shall be Type "K" sweat soldered.

## 2.4 PLASTIC PIPE AND FITTINGS

- A. Pipe shall be marked continuously with manufacturer's name, nominal pipe size, schedule or class, PVC type and grade, National Sanitation Foundation approval, Commercial Standards designation, and date of extrusion.
- B. All plastic pipe shall be extruded of an improved PVC virgin pipe compound in accordance with ASATM D2241 or ASTM D1784.
- C. All PVC fittings shall be standard weight Schedule 80 for constant-pressure mainline fittings and screwed fittings, and Schedule 40 for non-pressure lateral fittings and shall be injection molded of an improved virgin PVC fitting compound. Slip PVC fittings shall be the "deep socket" bracketed type. Threaded plastic fittings shall be injection molded. All tees and ells shall be side gated. All fittings shall conform to ASTM D2466 and D2467.
- D. All threaded nipples shall be standard weight Schedule 80 with molded threads and shall conform to ASTM D1785.
- E. All solvent cementing of plastic pipe and fittings shall be a two-step process, using primer and solvent cement applied per the manufacturer's recommendations. Cement shall be of a fluid consistency, not gel-like or ropy. Solvent cementing shall be in conformance with ASTM D2564 and ASTM D2855.
- F. When connection is plastic to metal, female adapters shall be hand tightened, plus one turn with a strap wrench. Joint compound shall be non-lead base Teflon paste, tape, or equal.

## 2.5 BASKET STRAINER

- A. The basket strainer unit shall be of the manufacturer, size, and type indicated on the drawings.
- B. The basket strainer unit shall be installed in accordance with the requirements set forth by local codes.

## 2.6 VALVES

- A. Gate Valves:
  - 1. Gate valves shall be of the manufacturer, size, and type indicated on the drawings.
  - 2. Gate valves shall have threaded ASTM B-62 bronze body, bonnet and wedge, silicon bronze stem, and malleable iron handwheel.
  - 3. All Gate valves shall have a minimum working pressure of not less than 150 psi and shall conform to AWWA standards.
- B. Quick Coupler Valves:
  - 1. Quick coupler valves shall be of the manufacturer, size, and type indicated on the drawings.

2. Quick coupler valves shall be brass with a wall thickness guaranteed to withstand normal working pressure of 150 psi without leakage. Valves shall have  $\frac{3}{4}$  female threads opening at base, with two-piece body. Valves to be operated only with a coupler key, designed for that purpose. Coupler key is inserted into valve and a positive, watertight connection shall be made between the coupler key and valve. Hinge cover shall be the locking type in color constructed of brass with a rubber-like vinyl cover. Vinyl quick coupler cover to be purple with the words "WARNING – RECLAIMED WATER – DO NOT DRINK" permanently marked on the lid.

C. Automatic Control Valves:

1. Automatic control valves shall be of the manufacturer, size, and type indicated on the drawings.
2. Automatic control valves shall be electrically operated.
3. Automatic control valves shall include manual flow adjustment.

D. Anti-drain Valves:

1. Anti-drain valves shall be of the manufacturer, size and type indicated on the drawings.
2. Anti-drain valves shall have 18-8 stainless steel springs and valve stems with Buna-N seals.
3. Anti-drain valves will have threaded connections the size of the riser or pipe they are to be installed onto, or the next available size. No slip connection anti-drain valves are allowed.

## 2.7 VALVE BOXES

- A. Valve boxes shall be fabricated from a durable, weather-resistant plastic material resistant to sunlight and chemical action of soils.
- B. The valve box cover shall be purple in color and permanently marked with words "WARNING – RECLAIMED WATER – DO NOT DRINK". Valve box cover shall be secured with a hidden latch mechanism or bolts.
- C. The cover and box shall be capable of sustaining a load of 1,500 pounds.
- D. Valve box extensions shall be by the same manufacturer as the valve box.
- E. Automatic control valve boxes shall be 16 inch x11 inch x12 inch rectangular size. Valve box covers shall be marked "RCV" with the valve identification number "heat branded" onto the cover in 2-inch high letters/numbers.
- F. Ball valve and quick coupler valve boxes shall be 10-inch diameter circular size. Valve box covers shall be marked with either "BV" or "QCV" with the valve identification "heat branded" onto the cover in 2-inch high letters.

## **2.8 AUTOMATIC CONTROLLER**

- A. Automatic controller shall be of the manufacturer, size, and type indicated on the drawings.
- B. Automatic controller enclosures shall be of the manufacturer, size, and type indicated on the drawings. Enclosure shall be vandal-resistant, ventilated and waterproof.

## **2.9 ELECTRICAL**

- A. All electrical equipment shall be NEMA Type 3, waterproofed for exterior installations.
- B. All electrical work shall conform to local codes and ordinances.

## **2.10 LOW VOLTAGE CONTROL WIRING**

- A. Remote control wire shall be direct-burial AWG-UF type, size in no case smaller than 14 gauge.
- B. Connections shall be either epoxy-sealed packet type or Penn-Tite connectors.
- C. Ground wires shall be white in color. Control wires shall be red (where two or more controllers are used, the control wires shall be a different color for each controller. These colors shall be noted on the "Record Drawings" plans located on controller door).

## **2.11 IRRIGATION HEADS**

- A. Sprinkler heads shall be of the manufacturer, size, type, with radius of throw, operating pressure and discharge rate indicated on the drawings.
- B. Pop-up heads and riser heads shall be used.
- C. Pop-up heads and gear driven rotors used on reclaimed water systems shall have a color coded purple cap with reclaimed water warnings embossed on the top surface Riser heads shall have a self-adhesive reclaimed water sticker placed on the riser directly below the sprinkler body. All reclaimed water warnings shall be in English and Spanish and have the international symbol for "Do Not Drink". All reclaimed water warnings shall be as required by the local water utility.

## **2.12 DRIP IRRIGATION COMPONENTS**

- A. Dripline tubing shall be of the manufacturer, model number and distribution (emitter flow and spacing) indicated on the drawings.
- B. Drip emitters, bubblers and micro-sprays shall be of the manufacturer and model number indicated on the drawings.
- C. Distribution tubing, connectors and insert or compression fittings shall be of the manufacturer and type indicated on the drawings.

## 2.13 RAIN SENSOR

Rain sensor shall be of the manufacturer, size, and type indicated on the drawings.

## PART 3 - EXECUTION

### 3.1 SITE CONDITIONS

#### A. Inspections:

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
2. Verify that irrigation system may be installed in accordance with all pertinent codes and regulations, the original design, the referenced standards, and the manufacturer's recommendations.

#### B. Discrepancies:

1. In the event of discrepancy, immediately notify the Landscape Architect or District's authorized representative.
2. Do not proceed with installation in areas of discrepancy until all discrepancies have been resolved.

#### C. Grades:

1. Before starting work, carefully check all grades to determine that work may safely proceed, keeping within the specified material depths with respect to finish grade.
2. Final grades shall be accepted by the Engineer before work on this section will be allowed to begin.

#### D. Field Measurements:

1. Make all necessary measurements in the field to ensure precise fit of items in accordance with the original design. Contractor shall coordinate the installation of all irrigation materials with all other work.
2. All scaled dimensions are approximate. The Contractor shall check and verify all size dimensions prior to proceeding with work under this section.
3. Exercise extreme care in excavating and working near existing utilities. Contractor shall be responsible for damages to utilities which are caused by his operations or neglect.

#### E. Diagrammatic Intent:

The drawings are essentially diagrammatic. The size and location of equipment and fixtures are drawn to scale where possible. Provide offsets in piping and changes in equipment locations as necessary to conform to structures and to avoid obstructions or conflicts with other work.

#### F. Layout:

1. Prior to installation, the Contractor shall stake out all pressure supply lines, routing and location of sprinkler heads, valves, backflow preventor, and automatic controller.
2. Layout irrigation system and make minor adjustments required due to differences between site and drawings. Where piping is shown on drawings under paved areas, but running parallel and adjacent to planted areas, install the piping in the planted areas.

G. Water Supply

Connections to, or the installation of, the water supply shall be at the locations shown on the drawings. Minor changes caused by actual site conditions shall be made.

H. Electrical Service:

1. Connections to the electrical supply shall be at the locations shown on the drawings. Minor changes caused by actual site conditions shall be made.
2. Contractor shall make 120 volt connection to the irrigation controllers. Electrical power source to controller locations shall be provided by others.

### 3.2 TRENCHING

- A. Excavations shall be straight with vertical sides, even grade, and support pipe continuously on bottom of trench. Trenching excavation shall follow layout indicated on drawings to the depths below finished grade and as noted. Where lines occur under paved area, these dimensions shall be considered below subgrade.
- B. Provide minimum cover of 24 inches on pressure supply lines 4 inches and larger. Provide minimum cover of 18 inches on pressure supply lines 3 inches and smaller.
- C. Provide minimum cover of 18 inches for control wires.
- D. Provide minimum cover of 12 inches for non-pressure lines.
- E. Pipes installed in a common trench shall have a 6-inch minimum space between pipes.

### 3.3 BACKFILLING

- A. Backfill material on all lines shall be the same as adjacent soil free of debris, litter, and rocks over 1/2 -inch in diameter
- B. Backfill shall be tamped in 4-inch layers under the pipe and uniformly on both sides for the full width of the trench and the full length of the pipe. Backfill materials shall be sufficiently damp to permit thorough compaction, free of voids. Backfill shall be compacted to dry density equal to adjacent undisturbed soil and shall conform to adjacent grades.
- C. Flooding in lieu of tamping is not allowed.
- D. Under no circumstances shall truck wheels be used to compact backfill.

- E. Provide sand backfill a minimum of 6 inches over and under all piping under paved areas.

### 3.4 PIPING

- A. Piping under existing pavement may be installed by jacking, boring, or hydraulic driving. No hydraulic driving is permitted under asphalt pavement.
- B. Cutting or breaking of existing pavement is not permitted unless specifically indicated on the drawings.
- C. Carefully inspect all pipe and fittings before installation, removing dirt, scale, burrs and reaming. Install pipe with all markings up for visual inspection and verification.
- D. Remove all dented and damaged pipe sections.
- E. All lines shall have a minimum clearance of 6 inches from each other and 12 inches from lines of other trades.
- F. Parallel lines shall not be installed directly over each other.
- G. In solvent welding, use only the specified primer and solvent cement and make all joints in accordance with the manufacturer's recommended methods including wiping all excess solvent from each weld. Allow solvent welds at least 15 minutes setup time before moving or handling and 24 hours curing time before filling.
- H. PVC pipe shall be installed in a manner which will provide for expansion and contraction as recommended by the pipe manufacturer.
- I. Centerload all plastic pipe prior to pressure testing.
- J. All threaded plastic-to-plastic connections shall be assembled using Teflon tape.
- K. For plastic-to-metal connections, work the metal connections first. Use a non-hardening pipe dope on all threaded plastic-to-metal. All plastic-to-metal connections shall be made with plastic female adapters.
- L. All solvent weld mainline piping is to be secured with minimum one cubic foot thrust blocks at all directional changes. Bell and gasket pipe to have a Leemco joint restraint system installed on all fittings in lieu of thrust blocks.

### 3.5 CONTROLLER

- A. The exact location of the controller shall be approved by the Landscape Architect or District's authorized representative before installation. The electrical service shall be coordinated with this location.
- B. The Irrigation Contractor shall be responsible for the final electrical hook up to the irrigation controller.

- C. The irrigation system shall be programmed to operate during the periods of minimal use of the design area or in accordance with the irrigation schedule provided.

### **3.6 CONTROL WIRING**

- A. Low voltage control wiring shall occupy the same trench and shall be installed along the same route as the pressure supply lines whenever possible.
- B. Where more than one wire is placed in a trench, the wiring shall be taped together in a bundle at intervals of 10 feet. Bundle shall be secured to the mainline with tape at intervals of 20 feet.
- C. All connections shall be of an approved type and shall occur in a valve box. Provide an 18-inch service loop at each connection.
- D. An expansion loop of 12 inches shall be provided at each wire connection and/or directional change, and one of 24 inches shall be provided at each remote control valve.
- E. A continuous run of wire shall be used between a controller and each remote control valve. Under no circumstances shall splices be used without prior approval.
- F. Pull boxes for low voltage control wires shall be provided at a spacing of 480 feet on center along the wire route. An expansion loop of 24 inches shall be provided at each control wire pull box.

### **3.7 VALVES**

- A. Automatic control valves, manual valves, gate valves, and ball valves are to be installed in the approximate locations indicated on the drawings.
- B. Valve shall be installed in shrub areas whenever possible.
- C. Install all valves as indicated on the drawings.
- D. Valves to be installed in valve boxes shall be installed one valve per box.

### **3.8 VALVE BOXES**

- A. Valve boxes shall be installed in shrub areas whenever possible.
- B. Each valve box shall be installed on a foundation of 3/4 inch gravel backfill, 3 cubic feet minimum. Valve boxes shall be installed with their tops 1/2 inch above the surface of surrounding finish grade in lawn areas and 2 inches above finish grade in ground cover areas.

### **3.9 BASKET STRAINER**

- A. Install basket strainer unit.



- B. Install basket strainer at location approved in the field and at height required by local codes.

### **3.10 SPRINKLER HEADS**

- A. Sprinkler heads shall be installed as indicated on the drawings.
- B. Spacing of heads shall not exceed maximum indicated on the drawings.
- C. Riser nipples shall be of the same size as the riser opening in the sprinkler body.
- D. Pop-up sprinkler heads shall not be installed using side outlet openings.

### **3.11 DRIP IRRIGATION**

- A. Provide sample layout for one complete drip valve control zone, including all components, dripline and/or emitter spacing and wire staples, for review and approval by Landscape Architect.
- B. Thoroughly flush all driplines and distribution tubing prior to installing drip emitters, air relief valves, flush valves and similar components.
- C. All drip irrigation shall be installed prior to installation of plant material.

### **3.12 MISCELLANEOUS EQUIPMENT**

- A. Install all assemblies specified herein according to the respective detail drawings or specifications, using best standard practices.
- B. Quick coupler valves shall be set approximately 12 inches from walks, curbs, header boards, or paved areas where applicable.
- C. Unless designed as an integral part of the irrigation head, anti-drain valves will be installed under every head. The anti-drain valve will be the same diameter as the riser and be integral to the riser assembly.
- D. Install rain sensors as indicated on the drawings and as recommended by the manufacturer.

### **3.13 FLUSHING THE SYSTEM**

- A. Prior to installation of sprinkler nozzles, the valves shall be opened and a full head of water used to flush out the lines and risers.
- B. Sprinkler nozzles shall be installed after flushing the system has been completed.

### **3.14 ADJUSTING THE SYSTEM**

- A. Contractor shall adjust valves, align heads, and check coverage of each system prior to coverage test.
- B. If it is determined by the Landscape Architect or District's authorized representative that additional adjustments or nozzle changes will be required to provide proper coverage, all necessary changes or adjustments shall be made prior to any planting.
- C. Automatic control valves are to be adjusted so that the sprinkler heads operate at the pressure recommended by the manufacturer.

### **3.15 TESTING AND OBSERVATION**

- A. Do not allow or cause any of the work of this section to be covered up or enclosed until it has been observed, tested and accepted by the Landscape Architect, District, and/or governing agencies.
- B. The Contractor shall be solely responsible for notifying the Landscape Architect, District, and governing agencies, a minimum of 48 hours in advance, where and when the work is ready for testing.
- C. When the sprinkler system is completed, the Contractor shall perform a coverage test of each system in its entirety to determine if the water coverage for the planted areas is complete and adequate in the presence of the Landscape Architect.
- D. The Contractor shall furnish all materials and perform all work required to correct any inadequacies of coverage due to deviations from the plans, or where the system has been willfully installed when it is obviously inadequate, without bringing this to the attention of the Landscape Architect.
- E. Final inspection will not commence without completed record drawings as prepared by the Irrigation Contractor.

### **3.16 MAINTENANCE**

During the maintenance period the Contractor shall adjust and maintain the irrigation system in a fully operational condition providing complete irrigation coverage to all intended plantings.

### **3.17 COMPLETION CLEANING**

Clean-up shall be made as each portion of the work progresses. Refuse and excess dirt shall be removed from the site, all walks and paving shall be broomed, and any damage sustained on the work of others shall be repaired to original conditions.

**END OF SECTION 32 84 00**

**RLA**  
005.2882.000

January 10, 2021  
DSA Back Check

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, CA

## SECTION 32 91 13 - SOIL PREPARATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes planting soils specified by composition of the mixes.
- B. Related Requirements:
  - 1. Section 311000 Site Clearing for topsoil stripping and stockpiling.

#### 1.2 DEFINITIONS

- A. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- B. Imported Soil: Soil that is transported to Project site for use.
- C. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- E. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- F. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- G. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- H. USCC: U.S. Composting Council.

#### 1.3 PREINSTALLATION MEETINGS

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

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  
- B. LEED Submittals:
  - 1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
  
- C. Samples: For each bulk-supplied material in sealed containers labeled with content, source, and date obtained; providing an accurate representation of composition, color, and texture.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

#### **1.6 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Regional Materials: Imported soil, manufactured planting soil, and soil amendments and fertilizers shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

#### **2.2 PLANTING SOILS SPECIFIED BY COMPOSITION**

- A. Planting Soil Type: Existing, on-site surface soil, with the duff layer, if any, retained; modified to produce viable planting soil. Blend existing, on-site surface soil with the following soil amendments and fertilizers in the following quantities to produce planting soil.
  
- B. Planting-Soil Type: Imported, naturally formed soil from off-site sources and consisting of sandy loam soil according to USDA textures; and modified to produce viable planting soil.

1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches deep, not from agricultural land, bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Bermuda grass, poison oak, nutsedge, Canada thistle, bindweed, bentgrass, ground ivy, perennial sorrel, and brome grass.
  2. Additional Properties of Imported Soil before Amending: Soil reaction of pH 6 to 7 and minimum of 4 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
  3. Unacceptable Properties: Clean soil of the following:
    - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
    - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
    - c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches in any dimension.
  4. Amended Soil Composition: Blend imported, unamended soil with the soil amendments and fertilizers in the quantities as recommended in the soils report to produce planting soil.
- C. Planting-Soil Type: Manufactured soil consisting of manufacturer's basic topsoil blended in a manufacturing facility with sand, stabilized organic soil amendments, and other materials to produce viable planting soil.
1. Additional Properties of Manufacturer's Basic Soil before Amending: Soil reaction of pH 6 to 7 and minimum of 4 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
  2. Unacceptable Properties: Manufactured soil shall not contain the following:
    - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
    - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the manufactured soil.
    - c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches in any dimension.
  3. Blend manufacturer's basic soil with soil amendments and fertilizers in the quantities as recommended by the soils report to produce planting soil.

### **2.3 ORGANIC SOIL AMENDMENTS**

- A. Organic soil amendments shall be as manufactured by Tri-C Enterprises. Specific amendments will be selected and specified by Tri-C Enterprises per the recommendations in the Agronomics Soils Report.

### **2.4 FERTILIZER**

- A. Specific fertilizer will be selected and specified by Tri-C Enterprises per the recommendations in the Agronomic Soils Report.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Place planting soil and fertilizers according to requirements of the Agronomic Soils Report recommendations.
- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

### **3.2 BLENDING PLANTING SOIL IN PLACE**

- A. General: Mix amendments with in-place, unamended soil to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Preparation: Till unamended, existing soil in planting areas to a minimum depth of 12 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off District's property.
- C. Mixing: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them into full depth of unamended, in-place soil to produce planting soil.
  - 1. Mix fertilizer with planting soil no more than seven days before planting.
- D. Compaction: Compact blended planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

### **3.3 PROTECTION AND CLEANING**

- A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."

- B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
1. Storage of construction materials, debris, or excavated material.
  2. Parking vehicles or equipment.
  3. Vehicle traffic.
  4. Foot traffic.
  5. Erection of sheds or structures.
  6. Impoundment of water.
  7. Excavation or other digging unless otherwise indicated.
- C. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off District's property unless otherwise indicated.
1. Dispose of excess subsoil and unsuitable materials on-site where directed by District.

**END OF SECTION 32 91 13**



## SECTION 32 92 00 - TURF AND GRASSES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Seeding.
  2. Sodding.
  3. Turf renovation.
  4. Erosion-control material(s).
  5. Grass paving.
- B. Related Requirements:
1. Section 32 84 00 – Planting Irrigation
  2. Section 32 93 00 - Plants

#### 1.2 DEFINITIONS

- A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Topsoil: Soil produced off-site by homogenously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete or top surface of a fill or backfill before planting soil is placed.
- H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

- I. Surface Soil: Whatever soil is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

### **1.3 ACTION SUBMITTALS**

- A. Product Data: Prior to installation submit for review and approval specifications and product information on items being used on project. Submit bound with list of items as cover sheet. Conform to Section 013300 Submittal Procedures.

### **1.4 INFORMATIONAL SUBMITTALS**

- A. Certification of grass seed.
  - 1. Certification of each seed mixture for turfgrass sod.
- B. Product certificates.
- C. Maintenance Instructions: Recommended procedures to be established by District for maintenance of turf and hydroseeded areas during a calendar year. Submit before expiration of required initial maintenance period.

### **1.5 OBSERVATION SCHEDULE**

- A. Notify District in advance for the following inspections, according to the time specified:
  - 1. Pre-Job Conference – 7 days
  - 2. Final grade review – 48 hours
  - 3. Plant material review – 48 hours
  - 4. Plant layout review – 48 hours
  - 5. Soil preparation and planting operations review – 48 hours
  - 6. Pre-maintenance – 7 days
  - 7. Final inspection – 7 days
- B. No site visits shall commence without all items noted in previous observation reports either completed or remedied unless such compliance has been waived by the Architect.

### **1.6 QUALITY ASSURANCE**

- A. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory.
  - 1. The soil testing laboratory shall oversee soil sampling.
  - 2. Report suitability of tested soil for turf growth.

- a. State recommendations for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil for suitable healthy, viable plants.
- b. Report presence of problem salts, minerals, or heavy metals; if present, provide additional recommendations for corrective action.

B. Source Quality:

1. At least days prior to seeding and/or sodding submit documentation that all plant materials are available. Sod is subject to inspection after confirmation of ordering.
2. Materials are subject to inspection at place of growth and upon delivery for conformity to specifications. Inspection, approval and rejection can also take place at other times during progress of work.
3. Request, in writing, inspection of plant materials at place of growth.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and Federal laws, as applicable.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in “Specifications for Turfgrass Sod Materials” and “Specifications for Turfgrass Sod Transplanting and Installation” sections in TPI’s “Guideline Specifications to Turfgrass Sodding.” Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

## 1.8 MAINTENANCE SERVICE

- A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:
  1. Seeded Turf: 90 days from date of Substantial Completion.
  2. Sodded Turf: 90 days from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SEED

- A. Grass Seed: Label seed and provide in sealed containers with signed copies from vendor certifying that each container is fully labeled in compliance with State Agricultural Code and is in compliance with minimum requirements of these specifications. Provide fresh, clean, dry, new-crop seed complying with AOSA’s “Journal of Seed Technology: Rules for Testing Seeds”

for purity and germination tolerances. Wet, moldy or damaged seed will not be permitted.  
Provide seed mix per plan.

## 2.2 TURFGRASS SOD

- A. Turfgrass Sod: Certified, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with “Specifications for Turfgrass Sod Materials” in TPI’s “Guideline Specifications to Turfgrass Sodding.” Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.
- B. Turfgrass Species: Sod of grass species per plan.

## 2.3 INORGANIC SOIL AMENDMENTS

- A. The following soil amendments are to be used for bid purposes only. Specific amendments and fertilizer will be selected and specified after rough grading operations are complete and Contractor has had soil samples tested.
- B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through No. 40 (0.425-mm) sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Agricultural Gypsum: Minimum 98 percent calcium sulfate, finely ground with 90 percent passing through No. 50 (0.30-mm) sieve.
- E. Sand: Clean, washed, natural or manufactured, and free of toxic materials.
- F. Calcium Carbonate: 95 percent lime as derived from oyster shells.

## 2.4 ORGANIC SOIL AMENDMENTS

- A. The following soil amendments are to be used for bid purposes only. Specific amendments and fertilizer will be selected and specified after rough grading operations are complete and Contractor has had soil samples tested.
- B. Nitrogen Stabilized: 0.56 to 0.84 percent N based on dry weight for wood residual or rice hulls.
- C. Particle Size: 95 to 100 percent passing 6.35 mm standard sieve; 80 to 100 percent passing 2.33 mm standard sieve.
- D. Salinity: Ensure that saturation extract conductivity does not exceed 3.5 millimohs per centimeter at 25 degrees C. as determined by saturation extract method.

- E. Iron Content: Minimum 0.08 percent dilute acid soluble Fe on dry weight basis.
- F. Ash: 0 to 6 percent dry weight.

## 2.5 FERTILIZERS

- A. Planting Fertilizer: Granular or pelleted fertilizer consisting of the following percents by weight and mixed by commercial fertilizer supplier.
  - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potash by weight.
- B. Sulfate of potash: 0-0-50.
- C. Single super-phosphate: Commercial product containing 18 to 20 percent available Phosphoric Pentoxide, or other approved.
- D. Urea formaldehyde: 38-0-0.

## 2.6 PLANTING SOILS

- A. Planting Soil: Ensure silt plus clay content of top soil does not exceed 20 percent by weight, with a minimum 95 percent passing the 2.0 mm sieve. Do not allow the sodium absorption rate SAR to exceed 6. The electrical conductivity (ECE) of the saturation extract cannot exceed 3.0 millimohs per centimeter at 25 degrees C. Ensure boron content is less than 1 part per million as measured on the saturation extract. To ensure compliance with these requirements, submit samples of soil for analysis prior to and following backfilling.

## 2.7 PESTICIDES

- A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

## 2.8 WATER

- A. Provide clean, potable water.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Obtain certification that final grades to 1/10 foot have been established prior to commencing landscaping operations. Provide for inclusion of all amendments, settling, etc. Be responsible for shaping all planting areas as indicted on drawings or as required.

#### **3.2 TURF AREA PREPARATION**

- A. The following amendments are to be used for bid purposes only. Specific amendments and fertilizer will be selected and specified after rough grading operations are complete and Contractor has had soil samples tested.
- B. After proper finished grades have been verified or established, cross-rip all planting areas to a depth of 12", condition and fertilize soil in accordance with recommendations of soil testing laboratory and as approved by District. The following is for bid purposes only. Uniformly spread and cultivate amendments thoroughly by means of mechanical tiller into top 6 inches of soil. Application rates per 1,000 square feet:

Nitrogen stabilized organic amendment 4 cubic yards

16-16-16 Commercial Fertilizers 15 lbs.

Agricultural Gypsum 100 lbs.

Soil sulphur 20 lbs.

- C. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus ½ inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- D. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- E. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

#### **3.3 SEEDING**

- A. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at total rate of 5 to 8 lb/1000 sq. ft. (2.3 to 3.6 kg/92.9 sq. m).

- C. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas from hot, dry weather or drying winds by applying planting soil within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch (4.8 mm) and roll surface smooth.

### 3.4 SODDING

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
  - 1. Lay sod across slopes exceeding 1:3.
  - 2. Anchor sod on slopes exceeding 1:6 with steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.

### 3.5 TURF MAINTENANCE

- A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
- B. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain height appropriate for species without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowing.
- C. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with District's operations and others in proximity to the Work. Notify District before each application is performed.

### 3.6 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:
  - 1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage

exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).

2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

- B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

**END OF SECTION 32 92 00**



## SECTION 32 93 00 - PLANTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Soil Preparation.
  2. Planting.
  3. Staking.
  4. Hydroseeding.
  5. Clean up.
- B. Related Sections:
1. Section 32 84 00 – Planting Irrigation
  2. Section 32 91 13 – Soil Preparation
  3. Section 32 92 00 – Turf and Grasses

#### 1.2 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- C. Finish Grade: Elevation of finished surface of planting soil.
- D. Manufactured Topsoil: Soil produced off-site by homogenously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- E. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- F. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria and viruses.
- G. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

- H. Root Flare: Also called “trunk flare.” The area at the base of the plant’s stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- I. Subgrade: Surface or elevation of subsoil remaining after excavation is complete or the top surface of a fill or backfill before planting soil is placed.
- J. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- K. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

### 1.3 ACTION SUBMITTALS

- A. Product Data: Prior to installation submit for review and approval specifications and product information on items being used on project. Submit bound with list of items as cover sheet. Conform to Section 01300. For each type of product indicated, including soils.
  - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
  - 2. Pesticide and Herbicides: Include product label and manufacturer’s application instructions specific to the Project.
  - 3. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
- B. Samples of mineral and / or organic mulch.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Material test reports.
- C. Maintenance instructions: Recommended procedures to be established by District for maintenance of plants during a calendar year.

### 1.5 OBSERVATION SCHEDULE

- A. Notify Architect in advance for the following inspections, according to the time specified:

1. Pre-Job conference – 7 days
2. Final grade review – 48 hours
3. Plant material review – 48 hours
4. Plant layout review – 48 hours
5. Soil preparation and planting operations review – 48 hours
6. Pre-maintenance – 7 days
7. Final inspection – 7 days

- B. No site visits shall commence without all items noted in previous observation reports either completed or remedied unless such compliance has been waived by the Architect.

## 1.6 QUALITY ASSURANCE

- A. Soils Analysis: For each un-amended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory.

1. The soil-testing laboratory shall oversee soil sampling.
2. Report suitability of tested soil for plant growth.
  - a. State recommendations for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
  - b. Report presence of problem salts, minerals, or heavy metals; if present, provide additional recommendations for corrective action.

- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

- C. Source Quality:

1. At least 60 days prior to planting submit documentation that all plant materials are available. Materials are subject to inspection after confirmation of ordering.
2. Materials are subject to inspection at place of growth and upon delivery for conformity to specifications. Inspection, approval and rejection can also take place at other times during progress of work.
3. Request, in writing, inspection of plant materials at place of growth. Identify place of growth and quantity of plants to be inspected.
4. As described in the planting notes for tree tagging, the Architect may opt to either visit the tree nursery or review photographs submitted by the Contractor. In either case, visit the nursery and select trees conforming to specifications prior to review by the Architect.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and typing damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide

protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

- B. Handle planting stock by root ball.
- C. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
- D. Deliver fertilizer to site in original unopened containers bearing manufacturer's guaranteed chemical analysis, name, trade mark, and conformance to State law.
- E. Provide copies of receipts for all amendments specified in these specifications or in agronomic soils report.
- F. Deliver plants with legible identification labels. Label trees, evergreens, bundles of containers of like shrubs and groundcover plants. State correct plant name and size indicated on plant list. Use durable waterproof labels with water-resistant ink which will remain legible for at least 60 days.
- G. Protect plant material during delivery to prevent damage to root ball or desiccation of leaves.
- H. Notify Architect 7 days in advance of delivery of plant materials and submit itemization of plants in each delivery.
- I. Store plants in shade and protect from weather.
- J. Maintain and protect plant material in a healthy, vigorous condition.
- K. Exercise care in handling, loading, unloading and storing of plant materials. Replace damaged materials.

## 1.8 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
  - 1. Warranty Periods from date of end of 90-day maintenance period.
    - a. Trees: 12 months.
    - b. Shrubs, Vines, Ornamental Grasses, Ground Covers, Biennials, and Perennials: 90 days.
    - c. Annuals: 90 days.

## 1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.
  - 1. Maintenance Period for Trees and Shrubs: 90 days from date of Substantial Completion.
  - 2. Maintenance Period for Ground Cover and Other Plants: 90 days from date of Substantial Completion.
- B. Continuously maintain all site areas involved in this contract during the progress of work and during the maintenance period until final acceptance of the work by the District. Improper maintenance or possible poor condition of the project at the termination of the scheduled maintenance period may cause postponement of the final completion date of the Contract. Continue maintenance until acceptable to the District.
- C. Provide sufficient numbers of workers and adequate equipment to perform work during maintenance period.
- D. Maintenance period does not start until all elements of construction, planting, and irrigation for the complete project are in accordance with the contract documents for this project.
- E. Request an inspection to begin maintenance period after all planting and related work has been completed in accordance with other contract documents. Maintenance period commences after date of Substantial Completion as determined by Landscape Architect and confirmed in written notification by the District.
- F. Prior to commencement of maintenance period, ensure that all ground cover and lawn areas have been planted and that all lawn areas show an even, healthy stand of grass seedlings or sod, grass having been mown twice.
- G. Any day or days that there is failure to properly maintain plantings, replace suitable plants, perform weed control or maintain hardscape areas will not be credited as part of the 90 days maintenance. The project will not be segmented into maintenance phases.
- H. Keep paved areas free of silt, dirt, leaves and other planting area debris. Maintain these areas at least broom clean through the duration of the maintenance period, cleaning no less often than once per week.
- I. Guarantee: Guarantee plant material against any and all poor, inadequate or inferior materials and workmanship for one year. Replace plants found to be dead or in poor condition due to faulty materials or workmanship, at no extra cost to District.
- J. Replacement: Replace materials found to be dead, missing or in poor condition during the maintenance period immediately. The Architect is the sole judge of the acceptability of condition. Make replacements of materials within 15 days after condition develops or written notification from Architect has been sent. Architect has the right to make emergency repairs without releasing Contractor's guarantee and warranty to Architect.

- K. Prior to date of final inspection, acquire approved reproducible prints and finally record from the job record set, all changes made during construction and deliver them to Architect.
- L. Deliver guarantees to Architect.

## **PART 2 - PRODUCTS**

### **2.1 PLANT MATERIAL**

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Legend shown on Drawings and complying with ANSI Z60.1. Provide plant materials in accordance with the State Department of Agriculture's regulation for nursery inspections, rules and ratings. Provide plants with a normal habit of growth, sound, healthy, vigorous and free from insect infestations, plant diseases, sunscalds, and other disfigurements. Ensure tree trunks are sturdy and have well-hardened systems and vigorous and fibrous root systems which are not root or pot-bound. In the event of disagreement as to condition of root system, the root conditions of the furnished plants in containers will be determined by removal of earth from the roots of not less than two plants, or more than 2 percent of the total number of plants of each species or variety. Where container grown plants are from several sources, roots of not less than two plants of each species or variety from each source will be inspected. In the event that the sample plants inspected are found to be defective, the entire lot or lots of plants represented by the defective samples may be rejected. Plants rendered unsuitable for planting due to this inspection will be considered samples and will be provided at no cost to the District.
- B. Size of plants will comply with ANSI Z60.1 and correspond with that normally expected for species and variety of commercially available nursery stock or as specified on drawings. The minimum acceptable size of plants measured before pruning with the branches in normal position, must conform to the measurements specified in the plant list. If approved by the District, larger sized plants may be used. If larger plants are approved for use, the ball of earth or spread of roots for each plant will be increased proportionately.
- C. Plants not meeting requirements of these specifications are considered to be defective whether in place or not. They must be immediately removed and replaced with new acceptable and approved plants of the required size, species and variety.
- D. Pruning: Do not prune, trim, top or alter the shape of trees or plants except as approved.
- E. Provide plant material true to botanical and common name and variety as specified in Annotated Checklist of Woody Ornamental Plants in California, Oregon and Washington, published by University of California School of Agriculture (latest edition).
- F. Nursery Grown and Collected Stock: Grow under climatic conditions similar to those in locality of project; container-grown stock in vigorous, healthy condition, not root-bound or with root system hardened off. Use only liner stock plant material which is well established in removable containers or formed homogenous soil sections.

- G. Select trees which are aesthetically desirable and are good examples of the species. Trees with gashes, misshapen trunks or branches, topped leaders, structural defects, badly crossed branches, or other visual defects will not be accepted. If formal arrangements or consecutive order of plants is shown on Drawings, select stock for uniform height and spread to assure symmetry in planting.
- H. Seed: Label seed and provide in sealed containers with signed copies from vendor certifying that each container is fully labeled in compliance with State Agricultural Code and is in compliance with minimum requirements of these specifications. Wet, moldy or damaged seed will not be permitted, Provide seed mix per plan.

## 2.2 PLANTING SOILS

- A. Planting Soil (Import or Amended Top Soil) Ensure silt plus clay content of top soil does not exceed 20 percent by weight, with a minimum 95 percent passing the 2.0 mm sieve. Do not allow the sodium absorption ratio SAR to exceed 6. The electrical conductivity (ECE) of the saturation extract cannot exceed 3.0 millimohs per centimeter at 25 degrees C. Ensure boron content is less than 1 part per million as measured on the saturation extract. To ensure compliance with these requirements submit samples of soil for analysis prior to and following backfilling.

## 2.3 PLANTER MIX

- A. Planter Mix for all on-structure planters and plant container: provide custom topsoil (“Disney”) Mix by EarthWorks Soil Amendments, Inc., (951) 782-0260, to include the followings pre-blended items:
  - 1. Preblended items:
    - a. 85% sandy loam topsoil
    - b. 15% peat moss
    - c. 0.5 lbs. / cy Triple Super Phosphate (0-45-0)
    - d. 0.25 lbs. / cy Potassium Sulfate (0-0-50)
    - e. 1 lb. / cy Agricultural Gypsum
    - f. 0.2 lbs. / cy P.A.M. (soil aggregating polymer)
- B. Roof Deck Soil Mix
  - 1. On-structure Planter Soil (Mix “A”) – (bottom of planter to 8-inches below finish grade) – per cubic yard of mix.
    - a. 80% Over-structure Planter Sand (optional – 100% sand if weight is not a consideration).
    - b. 20% pumice (optional no pumice).
    - c. 2 lbs. Nitroform (38-0-0, 27% WIN).
    - d. 2 lbs. 12-12-12 General Planting Fertilizer.
    - e. 1 lb. iron sulfate.

- f. 2 lbs. dolomite lime.
  - g. 2 lbs. calcium carbonate limestone.
  - h. Thoroughly blend mix before placing soil in 12” lightly compacted lifts.
2. On-structure Planter Soil (Mix “B”) – (8-inch layer – place on top of On-structure Planter Soil (Mix “A”) up to finish grade) – per cubic yard of mix:
- a. 70% Over-structure Planter Sand.
  - b. 30% Organic Amendment.
  - c. 2 lbs. Nitroform (38-0-0, 27% WIN).
  - d. 1 lb. iron sulfate.
  - e. 2 lbs. dolomite lime.
  - f. 2 ls. Calcium carbonate limestone.
  - g. Thoroughly blend soil mix before placing soil in one lightly compacted lift.
3. Over-structure Planter-Sand:
- a. Washed nursery sand which meets following U.S. Standard Sieve criteria:

Sieve No. (U.S. Standard)	Weight Percent Passing
10	100
18	100
35	92
60	16
100	2.1
140	1.3
270	0.1

## 2.4 MULCHES

- A. Organic Mulch: Provide medium grind bark, consisting of organic, fibrous, woody bark mixture of varied particle size such that 90 to 100 percent passes 1 inch sieve, 80 59 100 percent passes 1/2-inch sieve, and 20 59 60 percent passes 1/4-inch sieve, or approved equal. Mulch shall be free of contaminants and weed seed and shall have a pleasant musty or moldy soil-like odor. Putrid, ammonia and sour-smelling materials will be deemed unacceptable. Recycled construction materials not be permitted.

## 2.5 HYDROSEEDING FIBER MULCH

- A. Provide Hydro-mulch as manufactured by Conwed, or other approved equal, composed of wood cellulose fiber and containing no germination or growth inhibiting factors. Ensure a consistent texture which disperses evenly and remains suspended in agitated water. Provide with a temporary green dye and the following percentage property analysis: moisture content 9 plus or minus 0.8; 3 o.d. basis, organic matter 99.2 plus or minus 0.8; ash content 0.8 plus or minus 0.2; pH 4.8 plus or minus 0.5; water holding capacity (grams of H2O per 100 grams of fiber 1150 minimum.



## 2.6 HYDROSEEDING ADDITIVE (BINDER)

- A. Provide Ecology Control-M-Binder organic seeding additive.

## 2.7 GUYING AND STAKING MATERIALS

- A. Wood Tree Stakes: lodge pole pine, full treated with Coppernaphthanate Wood Preservative in strict accordance with FS TT-W-572 Type I, Composition B, 2-inch minimal normal size diameter by 10 feet long, minimum, with no split stakes.
- B. Ties: Provide cinch ties, size corresponding to tree box size as manufactured by VIT Company or other approved.

## 2.8 LANDSCAPE EDGINGS

- A. Wood Edging:
  - 1. Provide 2-inch by 4-inch pressure treated Douglas Fir or Redwood construction grade headerboards. Make splices with 1-inch by 3-inch by 16-inch stakes at intervals of not more than 5 feet. Cut stakes level and set below top of headerboards.
  - 2. On sharp turns and curves, four 1/2 inch by 4-inch laminated boards, or two 1-inch by 4-inch laminated boards may be permitted.
  - 3. Nail stakes and splices with galvanized common nails. Nail as required for solid installation.
  - 4. Provide header as shown on drawings, laid true to line and grade, protect in-place adjacent improvements, shrubbery and other properties. Place stakes on ground cover side of header.
- B. Steel Edging: Standard commercial-steel edging, rolled edge, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.
- C. Aluminum Edging: Standard-profile extruded-aluminum edging, ASTM B221, Alloy 6063-T6, fabricated in standard lengths with interlocking sections with loops stamped from face of sections to receive stakes,
- D. Plastic Edging: Standard black polyethylene or vinyl edging, horizontally grooved, extruded in standard lengths, with 9-inch steel stakes.
- E. Concrete Mowstrip: 6-inch wide by 6-inch thick concrete mowstrip with 1/2-inch tooled edging and #3 continuous rebar.

## 2.9 MISCELLANEOUS PRODUCTS

- A. Sand: Provide washed silica sand.
- B. Water: Provide clean, potable water.

- C. Root Barrier: provide UB24-2 by Deep Root Corporation, (800) 458-7668. Install at all trees within 5 feet of concrete paving, curbs or mow strips or as shown on plans. Install barrier with vertical ribs facing forward the tree and wit the top edge 1/2 inch above finish grade. Length of root barrier shall extend 10' minimum in each direction from center of tree trunk. Provide linear root barrier adjacent to paving or curbing; root barrier shall not circle the rootball.
- D. Tree Trunk Protector: Provide ArborGard model AG 9-4 by Deep Root Corporation, (800) 458-7668.
- E. Erosion Control Fabric: Provide Rollmax SC-150 rolled erosion control fabric by North American Green, (800) 772-2040.

## **2.10 QUALITY CONTROL**

- A. Provide standard, approved and first-grade quality materials, in prime condition when installed and accepted. Deliver commercially processed and packaged materials in manufacturer's unopened containers bearing the manufacturer's guaranteed analysis. Supply a sample of all supplied materials accompanied by analytical data from an approved laboratory source illustrating compliance, or bearing the manufacturer's guaranteed analysis.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Obtain certification that final grades to 1/10 foot have been established prior to commencing landscaping operations. Provide for inclusion of all amendments, settling, etc. Be responsible for shaping all planting areas as indicated on drawings or as required.
- B. Inspect trees, shrubs and liner stock plant material for injury, insect infestation and trees and shrubs for improper pruning.
- C. Do not begin planting of trees until deficiencies are corrected or plants replaced.

### **3.2 PLANTING AREA ESTABLISHMENT**

- A. Soil Preparation: After proper finish grades have been verified or established, cross-rip all planting areas to a depth of 12 inches, condition and fertilize soil in accordance with recommendations of soil testing laboratory.
- B. At time of planting, ensure that top 2 inches of all areas to be planted or seeded are free of stones, stumps and other deleterious matter 1 inch in diameter or larger, and free from wire, plaster, concrete, wood and similar materials which would cause hindrance to planting or maintenance.
- C. Finish Grading: Make minor modifications to grade as may be necessary to establish required final grade. Ensure that finish grade provides proper drainage of the site and surface drainage is

away from building. Final grades are to be 1-inch below adjacent paved areas, sidewalks, valve boxes, headers, clean-outs, drains, manholes, etc., or as shown on drawings or required by City. Eliminate erosion scars prior to commencing maintenance period.

D. Pre-Plant Weed Control:

1. After irrigation system is operational, use a non-selective systemic contact herbicide as recommended and applied by an approved licensed landscape pest control advisor and applicator. Leave sprayed plants intact for at least 15 days.
2. Clear and remove these existing weeds by mowing or grubbing off all plant parts at least 2 inches below surface of soil over entire areas to be planted.
3. After irrigation system is operational, apply water for 10 days as needed to achieve weed germination. Apply contact herbicides and wait as needed before planting. Repeat as required.
4. Maintain weed free site until acceptance by District.

### 3.3 PLANTING INSTALLATION

A. General:

1. The irrigation system shall be operational and approved prior to planting.
2. Perform actual planting only during those periods when weather and soil conditions are suitable and in accordance with locally accepted practice, as approved.
3. Distribute in planting areas only as many plants as can be planted and watered that same day.
4. Ensure that containers which are opened and plants removed are handled with care such that ball of earth surrounding roots is not broken and that plants are planted and watered immediately. Do not open containers prior to placing plants in planting areas.

- B. Layout: Mark locations for plants and outlines of areas to be planted before any plant pits are dug. Gain City approval. If underground construction or utility lines are encountered in the excavation of planting areas, other locations for planting may be selected by District. Accomplish layout with flagged grade stakes indicating plant names and specified container size on each stake. Confirm location and depth of underground utilities and obstructions.

### 3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Trim perimeter of bottom leaving center area of bottom raised slightly to support rootball and assist in drainage away from center. Do not further disturb base. Ensure that rootball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

1. Excavate approximately two times as wide as rootball diameter.
2. Do not excavate deeper than depth of the rootball, measured from the root flare to the bottom of the rootball.

- B. Subsoil and topsoil removed from excavations may be used as planting soil backfill.
- C. Strip and stack approved excavation for planting which is encountered within areas for trenches, tree holes, plant pits and planting beds.
- D. Remove from site excess soil generated from planting holes and not used for backfilling.
- E. Protect areas from excessive compaction when trucking plants or other materials to planting areas.

### 3.5 TREE, SHRUB, AND VINE PLANTING

- A. Before planting, verify that root flare is visible at top of rootball according to ANSI Z60.1.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set stock plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
  - 1. Use planting soil for backfill.
  - 2. Container Grown: Cut cans on two sides with acceptable can cutter only. Carefully remove rootball from container without damaging rootball or plant. Superficially loosen edge roots on three sides after removing form can.
  - 3. Boxed Trees: Remove bottom of plant boxes before planting. Remove sides without damage to rootball after positioning plant and partially backfilling
  - 4. Boxed Trees: Remove bottom of plant boxes before planting. Remove sides without damage to rootball after positioning plant and partially backfilling.
  - 5. Face plants with fullest growth into prevailing wind.
  - 6. Backfill around rootball in layers, tamping to settle soil and eliminate voids and air pockets. Hold plant rigidly and plumb until soil has been firmed around ball or roots. Raise all plants which settle deeper than the surrounding grade. When planting pit is approximately one-half filled, add water to the top of the planting pit and thoroughly saturate rootball and adjacent soil.
  - 7. Set planting tablets with each plant on top of rootball while plants are still in their containers so the required number of tablets can be verified. After water has completely drained, place planting tablets as follows or in amounts recommended in soil reports from soil-testing laboratory.
    - 1 tablet per 1-gallon container
    - 2 tablets per 5-gallon container
    - 3 tablets per 15-gallon container
    - 4 tablets per 24-inch box
    - 6 tablets per 36-inch box
    - 8 tablets per 48-inch boxPlace tablets beside the rootball about 1 inch from root tips; do not place tablets in bottom of the hole.
  - 8. Continue backfilling process. Construct an earthen basin around each plant after backfilling. Provide basin of depth sufficient to hold at least 2 inches of water.

#### **ADDENDUM 3 - RFI 60**

**60. Q: Please provide material of planting tablet in Spec section 329300-12/ 3.5, 7**

**A: Agriform 20-10-05 (21gm)**

- Construct basins with amended backfill. Remove basin in all turf areas after initial watering. Water again after placing and tamping final layer of soil.
9. Limit pruning to minimum necessary. Remove injured twigs and branches. Pruning may not be done prior to delivery of plants. Paint cuts over 3/4 inch in diameter with tree paint.
  10. Stake or guy trees immediately after planting. Install stakes plumb. Locate stakes so that a straight line drawn between the stakes is perpendicular to the prevailing wind direction.
  11. Do not bring iron sulfate into contact with concrete surfaces due to potential staining. Contractor is responsible for cleaning and replacing stained surfaces.
- D. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the rootball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the rootball.

### **3.6 TREE, SHRUB, AND VINE PRUNING**

- A. Remove only dead, dying, or broken twigs or branches. Do not prune for shape. Pruning may not be done prior to delivery of plants.
- B. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

### **3.7 GROUNDCOVER AND OTHER SMALL CONTAINER PLANTING**

- A. Set out and space ground cover and plants from flats or containers smaller than 1-gallon as indicated on planting plan in even rows with triangular spacing.
- B. Ensure that groundcover remains in the flats until transplanting. Flats soil must contain sufficient moisture so it will not fall apart when lifting plants.
- C. Use planting soil for backfill. Plant each rooted plant with its proportionate amount of flat soil.
- D. Dig holes large enough to allow spreading of roots.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants for damage and trampling.

### **3.8 HYDROSEEDING**

- A. Install large trees and shrubs (t gallon and larger) if they occur in hydroseeded areas.

- B. Install trees and shrubs (1 gallon) and groundcovers from flats if they occur in hydroseeded areas.
- C. Provide seed mixes as shown on plan.
- D. Apply hydroseed by an approved hydro-mulch company.
- E. Apply in a form of slurry consisting of cellulose fiber, seed, chemical additives, commercial fertilizer and water. When hydraulically sprayed on soil, ensure that hydro-mulch forms a blotter like ground cover impregnated uniformly with seed and fertilizer and allows the absorption of moisture and rainfall to percolate to the underlying soil.
- F. Prepare the slurry at the site by first adding water to the tank when the engine is at half throttle. When water level has reached height of agitator shaft, provide full circulation, then add seed, followed by fertilizer, then mulch. Only add the mulch to the mixture after the seed and the tank is at least 1/3 filled with water. By the time the tank is 2/3 to 3/4 full, all mulch shall be in. Commence spraying immediately when tank is full.
- G. Spray uniform visible coat by using the green color as a guide. Apply the slurry in a sweeping motion, in an arched stream so as to fall like rain allowing the wood fibers to build on each other until a good coat is achieved and the material is spread at the required rates.
- H. Remove slurry not used within two hours from the site.
- I. Fill out the daily worksheets by the nozzle man with the following information: Seed type and amount, mulch type and amount, number of loads and amount of water, seeding additive type and amount, area covered and equipment used, capacity and license number.
- J. Do not allow any slurry to be sprayed into any reservoir basin or drainage ditches and channels which may impede the flow of rain or irrigation water. Clean up any spilled slurry.
- K. After application of hydro-mulch, wash excess material from previously planted materials and architectural features. Avoid washing or eroding mulch materials.
- L. Ensure that application equipment has a built-in agitation system and operating capacity sufficient to agitate, suspend and mix a slurry containing not less than 40 pounds of fiber mulch plus a combined total of 7 pounds fertilizer solids for each 100 gallons of water.
- M. Slurry distribution lines shall be large enough to prevent stoppage and shall be equipped with a set of hydraulic spray nozzles which will provide a continuous non-fluctuating discharge. Capacity requirement is 1,500 gallons, mounted on a traveling unit, either self-propelled or drawing by a separate unit which will place slurry tank and nozzles within sufficient proximity of areas to be seeded.
- N. Hydraulic equipment used for pesticide applications shall consist of a clean 150-gallon capacity fiberglass tank, complete with mechanical agitation. Pump volume shall be 10 gallons per minute, while operating at a pressure of 100 pounds per square inch. Distribution lines shall be large enough to carry the volume of water necessary for even chemical distribution. Spray

nozzle must cover a 15-foot swatch, with a minimum output of 5 gallons per minute at 80 pounds per square inch.

### **3.9 PLANTING AREA MULCHING**

- A. Mulch backfilled surfaces of planting areas with 3-inch layer of mulch except slopes that are 2:1 or steeper, hydroseeded areas, turf areas and bioretention basin bottoms.

### **3.10 CLEAN-UP**

- A. After all planting operations are complete; remove all trash, excess soil, empty plant containers, and rubbish from the property. Repair scars, ruts and other marks in the ground and leave ground in a neat and orderly condition.
- B. Leave the site in a broom-clean condition and wash down all paved areas within the project site. Leave walks in a clean and safe condition.

### **3.11 LANDSCAPE MAINTENANCE**

- A. Weed and cultivate all areas at intervals of not more than 10 days.
- B. Perform watering, mowing, rolling, edging, trimming, fertilization, spraying, pest control, and cleaning as may be required.
- C. Street gutters and curbs are to be included.
- D. Maintain adequate protection for people and property, and be financially responsible for damages and injuries. Notify the Architect immediately should damage occur as a result of maintenance operations and provide repair or remuneration.
- E. Between the 15<sup>th</sup> and 20<sup>th</sup> calendar day of the maintenance period, reseed or resod all spots or areas within the lawn where normal turf growth is not evident.

### **3.12 TREE AND SHRUB CARE**

- A. Watering: Maintain a large enough water basin around plants so that enough water can be applied to establish moisture through the major root zone. When hand watering, use a water wand to break force of water.
- B. Pruning:
  - 1. Prior to any pruning, obtain written approval from the Architect to proceed.
  - 2. Trees:
    - a. Propose tree pruning to the Architect should there be health or structural reasons for doing so, including the need to eliminate structurally unsound growth, reduce

- potential for wind toppling or wind damage, or maintain growth within limited space.
- b. Tree pruning that is required during the Maintenance Period for tree health or structural reasons, or as direct by the City, shall be performed in accordance with ANSI A-300 ISA standards.
  - c. Major pruning of deciduous trees shall be during their dormant season.
3. Shrubs:
- a. The objectives of shrub pruning are the same as for trees. Do not clip shrubs into balled or boxed forms unless such is required by the design.
  - b. Make pruning cuts to lateral branches or buds or flush with trunk. Stubbing will not be permitted.
- C. Staking and guying: Ensure that stakes and guys remain in place through acceptance and monitor to prevent girdling of trunks or branches and to prevent rubbing that causes bark wounds. All nursery stakes shall be removed.
- D. Weed control: Keep all areas free of weeds. Use recommended legally approved herbicides. Avoid frequent soil cultivation that destroys shallow roots. Use mulches per specifications to help prevent weed seed germination.
- E. Insect and disease control: Maintain a reasonable control with approved materials.
- F. Fertilize as specified by the agronomic soils testing recommendations and as follows for bid purposes
1. Commencement of maintenance period – 6 pounds per 1,000 square feet with top dress fertilizer.
  2. At the end of first 30 days of maintenance period – 6 pounds per 1,000 square feet with top dress fertilizer.
  3. At end of maintenance period and at 30-day intervals should maintenance period be extended for any reason – 6 pounds per 1,000 square feet with fertilizer mix.
  4. Avoid applying fertilizer to the rootball and base of main stem: rather, spread evenly under plant to dripline. Rates will vary from about a cup of nitrate fertilizer (depending upon nitrogen percentage) around a newly installed small plant to about ½ pound of actual nitrogen per inch of trunk diameter measured four feet from the ground for mature trees.
- G. Replacement of plants: Replace dead, dying and missing plants with plants of a size, condition and variety acceptable to the Architect.

### 3.13 GROUND COVER CARE

- A. Weed control: Control weeds, preferably with pre-emergent herbicides, but also by hand or with selective systemic herbicides. Hoe weeds as little as possible since this may result in plant damage.



- B. Watering: Water enough that moisture penetrates throughout root zone and only as frequently as is necessary to maintain healthy growth.
- C. Trash: Remove as it accumulates, but no less often than weekly.
- D. Edging and trimming: Edge groundcover to keep in bounds.
- E. Replace dead and missing plants.

### **3.14 LAWN AND TURF CARE**

- A. Turf must be well-established prior to final acceptance.
- B. Watering: Water lawns at such frequency as weather conditions required to replenish soil moisture below root zone.
- C. Weed control: If needed, control broad leaf weeds with selective herbicides.
- D. Mowing:
  - 1. Perform mowing at such times of the day or week as may be requested by the District so as not to impede the District's operations. Mowing times may be at times other than normal working hours or days. Perform work at District's convenience.
  - 2. Clean up grass clippings during and after mowing, and remove legally from site. Use of blowing type equipment in lieu of sweeping or vacuuming is not acceptable.
- E. Renovating:
  - 1. If required, remove thatch by verticutting preferable in the Fall of the year, but otherwise in the Spring. At this time, fertilize with nitrate and over-seed if needed. Over-seeding must precede pre-emergent herbicides by at least 4 to 6 weeks. Normally, this means that lawns which have been invaded by crabgrass would be renovated and over-seeded in the Fall and treated for crabgrass control in the following late Winter.
  - 2. Clean up grass clippings during and after mowing, and remove legally from site. Use of blowing type equipment in lieu of sweeping or vacuuming is not acceptable.

### **3.15 IRRIGATION SYSTEM**

- A. Inspection: Check all systems for proper operation. Lateral lines must be flushed out after removing the last sprinkler head or two at each end of the lateral. Adjust heads as necessary for unimpeded coverage and no overspray.
- B. Controllers: Set and program automatic controllers for seasonal water requirements. Give District a key to controllers and instruction on how to turn off system in case of emergency as specified in other sections of these specifications.
- C. Repair all damages to irrigation system. Make all repairs within one watering period.

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January 10, 2021  
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**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, CA

END OF SECTION 32 93 00

## SECTION 33 11 00 – WATER UTILITY DISTRIBUTION PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Requirements: Provide water distribution system, complete, as indicated on the Drawings or inferable therefrom and/or as specified in accordance with the Contract Documents.

#### 1.2 SUBMITTALS

- A. Product Data: Submit copies of manufacturer's specifications and installation instructions for each material. Include certification or other data verifying compliance with required characteristics. Indicate by transmittal form that copy of each has been distributed to the Installer.
- B. Shop Drawings: Submit layout and shop drawings as required under Section Submittals. Include details of reinforced concrete structures.
- C. Test Reports: Submit certified Test Reports showing compliance of the following items in accordance with Section General Conditions.
  - 1. Laboratory test for bedding and trench stabilization materials.
  - 2. Concrete design mix.
  - 3. Compression tests.
  - 4. Water Test Reports: Submit results of water sample tests by State or local health authorities

#### 1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
  - 2. All work to be performed and materials to be used shall be in accordance with the Standard Specifications for Public Works Construction, latest edition and supplements.
  - 3. The Contractor shall have one copy of the Standard Specifications at the job site.
  - 4. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the Work. The legal/contractual relationship sections and the measurement and pavement sections do not apply to this document.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with FM's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

- D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- E. NSF Compliance:
  - 1. Comply with NSF 14 for plastic potable-water-service piping.
  - 2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

#### **1.4 PROJECT CONDITIONS**

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify owner's representative not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without a written permission from owner's representative.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Prevent damage to materials during loading, transportation, and unloading. Store equipment with moving parts off ground on platforms or skids.

#### **1.6 COORDINATION**

- A. Coordinate connection to water main with utility company.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

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

## 2.2 PIPE AND FITTINGS

- A. PVC, AWWA Pipe (NPS 4 to NPS 12): AWWA C900, Class 305 DR 14, with bell-and-spigot or double-bell ends.
  - 1. PVC to PVC Fittings: Push-on-Joint, PVC Fittings, ASTM 3139, with elastomeric gasket bell ends, conforming to ASTM D2122 for bell measurements.
  - 2. PVC to Metal Fittings, Valves, and Accessories: Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts. Use corrosion resistant, high strength, low alloy steel, bolts and nuts where in contact with corrosive soil ASTM A 325.

## 2.3 VALVES

- A. AWWA, UL/FM Cast-Iron, Gate Valves:
  - 1. Nonrising-Stem, Resilient-Seated Gate Valves: AWWA C509 and UL/F.M. approved, gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
    - a. Minimum Working Pressure: 200 pounds per square inch gauge (psig).
    - b. End Connections: Flanged, push-on rubber gasketed, or mechanical joint, as required.
    - c. Interior Coating: Complying with AWWA C550.

## 2.4 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," bottom section with base of size to fit over valve, and approximately five-inch diameter barrel. Fabricate valve box cover to fit snugly to prevent displacement by traffic.
  - 1. Operating Wrenches: Steel tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
- B. Vertical-Type Indicator Posts: UL 789, FM-approved, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve with tamperproof electrical supervisory switch for connection to the fire alarm control panel system.

## 2.5 VALVE APPLICATION

- A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FM,

nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.

1. Where specific valve types are not indicated, the following requirements apply:
  - a. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated, gate valves with valve box.
  - b. Underground Valves, NPS 4 and Larger, for Vertical-Type Indicator Posts: UL/FM, Cast-iron, nonrising-stem gate valves with indicator post.

## **2.6 CORROSION-PROTECTION ENCASUREMENT FOR PIPING**

- A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch minimum thickness, tube or sheet.

## **2.7 WATER METERS**

- A. Water meter(s) indicated on drawings shall be installed by the local water purveyor for the area, unless noted otherwise.

## **2.8 BACKFLOW-PREVENTION DEVICES**

- A. General: FM Approved, AWWA, UL Classified, Approved by the Foundation for Cross Connection Control and Hydraulic Research at the University of Southern California.
  1. Working Pressure: 175 pounds per square inch (psi) minimum, unless otherwise indicated.
  2. Interior Components: Corrosion-resistant materials.
  3. Exterior Components: Assembly shall be provided with flanged connections, galvanized cast-iron or epoxy coated construction.
- B. Reduced-Pressure-Principle Backflow Preventers: Suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet; test cocks; and pressure-differential relief valve with ASME A112.1.2, air-gap fitting located between two positive-seating check valves. Include tamperproof electrical supervisory switch for connection to tie the fire alarm control panel system.
- C. Double-Check-Valve Backflow Prevention Assemblies: Suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet; test cocks; and two positive-seating check valves. Include tamperproof electrical supervisory switch for connection to tie the fire alarm control panel system.

## **2.9 FIRE HYDRANTS**

- A. Before procurement, verify approval has been issued by the Fire Department having jurisdiction.

- B. Wet-Barrel Fire Hydrants: AWWA C503 or UL 312, one NPS 4 and two NPS 2-1/2 outlets, NPS 6 threaded or flanged inlet, and base section with NPS 6 mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant shall have 150 pounds per square inch gauge (psig) minimum working-pressure design.
  - 1. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
  - 2. Operating and Cap Nuts: Pentagon, one-and-one-half inches point to flat.
  - 3. Direction of Opening: Open hydrant valves by turning operating nut to left or counterclockwise.
- C. Combined length of bury and extension shall be as indicated. Where not indicated, install top of hydrant flange three inches above finished surface.
- D. Exterior Finish: "O.S.H.A. safety yellow" Ameritone 719 or approved equal after receiving a prime coat.

## 2.10 FIRE DEPARTMENT CONNECTIONS

- A. Exposed, Freestanding, Fire Department Connections: UL 405, cast-bronze body, with thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch high brass sleeve; and round escutcheon plate, and all appropriate check valves per NFPA 24.
  - 1. Escutcheon Plate Marking: "AUTO SPKR."

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Examination: Examine substrates, adjoining construction and conditions under which Work is to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected

### 3.2 PREPARATION

- A. Field Measurements: Verify dimensions before proceeding with Work. Obtain field measurements for work required to be accurately fitted to other construction. Be responsible for accuracy of such measurements and precise fitting and assembly of finished work.

### 3.3 JOINT CONSTRUCTION

- A. Make pipe joints according to the following:

1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
3. Copper Tubing Soldered Joints: ASTM B 828. Use flushable flux and lead-free solder.
4. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
5. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

### 3.4 PIPING INSTALLATION

- A. Project site water lines shall terminate approximately five feet from buildings, unless otherwise indicated on Drawings. Install temporary cap or plug terminals for future connection to building.
- B. Bury piping with depth of cover over top at least 36 inches, unless otherwise indicated.
- C. Comply with NFPA 24 for fire-service-main piping materials and installation.
- D. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
- E. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
- F. Install PVC, AWWA pipe according to AWWA M23 and ASTM F 645.
- G. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports for all lines NPS 3 or greater.
- H. Water Main Connection: Arrange and pay for tap in the water main, water meter, and all associated fees from the water purveyor.

### 3.5 CLEARANCE OF WATER LINE

- A. Building or Structure: Two feet minimum horizontal separation.
- B. Sewer crossing:
  1. Typical Conditions: Lay water mains over sanitary sewers to provide vertical separation minimum three feet.
  2. Unusual Conditions: If above separation cannot be met, for sewers less than three feet below the water pipe, use the following:
    - a. Install water line with all joints located at least four feet from each side of the sewer pipe.
    - b. Sewer pipe encased in six inches concrete around pipe, and extend four feet either side of water main.



- C. Parallel to Sewer Line: Water line shall not be installed in a common trench with the building sanitary sewer unless both of the following requirements are met:
1. The bottom of the water pipe, at all points, shall be at least 12 inches above the top of the sewer.
  2. The water pipe shall be placed on a solid shelf excavated at one side of the common trench with a minimum clear horizontal distance of at least 12 inches from the sewer.

### **3.6 ANCHORAGE INSTALLATION**

- A. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches for all lines NPS 3 or greater. Include anchorages for the following piping systems:
1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
  2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
  3. Fire-Service-Main Piping: According to NFPA 24.
  4. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

### **3.7 VALVE INSTALLATION**

- A. Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. Vertical-Type Indicator Post Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post. Include tamperproof electrical supervisory switch for connection to tie the fire alarm control panel system.

### **3.8 BACKFLOW-PREVENTER INSTALLATION**

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers with relief drain in vault or other space subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support three-inch and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.
- E. Access and clearance shall be provided for the required testing, maintenance and repair. Access and clearance shall require a minimum of one foot between the lowest portion of the assembly and grade or platform.

- F. Include tamperproof electrical supervisory switch for connection to tie the fire alarm control panel system.

### **3.9 FIRE HYDRANT INSTALLATION**

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
- B. UL/FM-Type Fire Hydrants: Comply with NFPA 24.

### **3.10 FIRE DEPARTMENT CONNECTION INSTALLATION**

- A. Install fire department connections of types and features indicated.
- B. Install ball drip valves at each check valve for fire department connection to mains.

### **3.11 IDENTIFICATION**

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-service piping. Locate below finished grade, directly over piping. Refer to Division 31 Section "Earth Moving" for tape specifications.

### **3.12 FIELD QUALITY CONTROL**

- A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: The piping shall be subjected for a minimum of two hours to a pressure of one and one-half times the working pressure, but in no case less than 150 pounds per square inch (psi). Examine all exposed pipe, joints, fittings and accessories during the test period. Replace or repair defective portions of the system, and repeat tests until results are satisfactory.
  - 1. Allowable leakage shall be as specified in AWWA C-600, Table 3.
- C. Prepare reports of testing activities.

### **3.13 CLEANING**

- A. Clean and disinfect water-distribution piping as follows:
  - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.

2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or as described below:
  - a. Fill system or part of system with water/chlorine solution containing at least 50 parts per million (ppm) of chlorine; isolate and allow to stand for 24 hours, or
  - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 parts per million (ppm) of chlorine; isolate and allow to stand for three hours.
  - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
  - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
  
- B. Prepare reports of purging and disinfecting activities.

**END OF SECTION 33 11 00**

## SECTION 33 31 00 – SANITARY UTILITY SEWERAGE PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes gravity-flow, nonpressure sanitary sewerage outside the building, with the following components:
  - 1. Cleanouts.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water.

#### 1.3 SUBMITTALS

- A. Manufacturer's product data for pipe and fittings.
- B. Field quality-control test reports.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

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

#### 2.2 PVC PIPE AND FITTINGS

- A. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

### 2.3 NONPRESSURE-TYPE PIPE COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
  - 1. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
  - 2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- C. Shielded, Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- D. Ring-Type, Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

### 2.4 CLEANOUTS

- A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
  - 1. Top-Loading Classification: Extra-heavy duty.
  - 2. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.
- B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

### 2.5 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
  - 1. Cement: ASTM C 150, Type II.
  - 2. Fine Aggregate: ASTM C 33, sand.
  - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
  - 4. Water: Potable.
- B. Portland Cement Design Mix: 3,250 pounds per square inch (psi) minimum, with 0.45 maximum water/cementitious materials ratio.
  - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
  - 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

- C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 3,250 pounds per square inch (psi) minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
  - 1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
    - a. Invert Slope: Two percent through manhole unless otherwise noted.
  - 2. Benches: Concrete, sloped to drain into channel.
    - a. Slope: Four percent.
- D. Ballast and Pipe Supports: Portland cement design mix, 3,250 pounds per square inch (psi) minimum, with 0.45 maximum water/cementitious materials ratio.
  - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
  - 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

### **PART 3 - EXECUTION**

#### **3.1 PIPING APPLICATIONS**

- A. Pipe couplings and fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
  - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
    - a. Shielded flexible couplings for same or minor difference OD pipes.
    - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
    - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction if shown on plan, otherwise use fittings. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of one percent, unless otherwise indicated.
  2. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
  3. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
- F. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

### 3.2 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure, drainage piping according to the following:
1. 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.
  2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
  3. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
  4. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-gasket joints.
  5. Join dissimilar pipe materials with nonpressure-type, flexible couplings.

### 3.3 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 15 Section "Sanitary Waste and Vent Piping."
- B. Make connections to existing piping and underground manholes.
1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus six-inch overlap, with not less than six inches of concrete with 28-day compressive strength of 3,250 pounds per square inch (psi).

### 3.4 FIELD QUALITY CONTROL

- A. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
  2. Test completed piping systems according to requirements of authorities having jurisdiction.
  3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours advance notice.
  4. Submit separate report for each test.

5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
    - a. Allowable leakage is maximum of 50 gallons/inch of nominal pipe size per mile of pipe, during 24-hour period.
    - b. Close openings in system and fill with water.
    - c. Purge air and refill with water.
    - d. Disconnect water supply.
    - e. Test and inspect joints for leaks.
    - f. Option: Test ductile-iron piping according to AWWA C600, "Hydrostatic Testing" Section. Use test pressure of at least 10 pounds per square inch gauge (psig).
  6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
    - a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
- B. Leaks and loss in test pressure constitute defects that must be repaired.
- C. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

**END OF SECTION 33 31 00**



## **SECTION 33 41 00 – STORM UTILITY DRAINAGE PIPING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes gravity-flow, nonpressure storm drainage pipe and drainage structures outside the building.

#### **1.2 PERFORMANCE REQUIREMENTS**

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product installed.
- B. Field quality-control test reports.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

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

#### **2.2 PVC PIPE AND FITTINGS**

- A. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.
- B. PVC Sewer Pipe and Fittings, NPS 18 and Larger: ASTM F 679, T-2 wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

### 2.3 NONPRESSURE-TYPE PIPE COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
  - 1. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
  - 2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- C. Shielded Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- D. Ring-Type Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

### 2.4 CLEANOUTS

- A. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

### 2.5 MANHOLES

- A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
  - 1. Diameter: Forty-eight inches minimum, unless otherwise indicated.
  - 2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
  - 3. Base Section: Six-inch minimum thickness for floor slab and four-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
  - 4. Riser Sections: Four-inch minimum thickness, and of length to provide depth indicated.
  - 5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
  - 6. Joint Sealant: ASTM C 990 bitumen or butyl rubber.
  - 7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
  - 8. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, one-half-inch steel reinforcing rods encased in ASTM D 4101, PP wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.

9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
10. Grade Rings: Reinforced-concrete rings, six- to nine-inch total thickness, to match diameter of manhole frame and cover.
11. Manhole Frames and Covers: Ferrous; 24-inch ID by seven- to nine-inch riser with four-inch-minimum width flange and 26-inch-diameter cover. Include indented top design with lettering cast into cover, using wording "STORM DRAIN."
  - a. Material: ASTM A 536, Grade 60-40-18 ductile iron or ASTM A 48, Class 35 gray iron, unless otherwise indicated.

## 2.6 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.
5. Ballast and Pipe Supports: Portland cement design mix, 3,000 pounds per square inch (psi) minimum, with 0.58 maximum water-cementitious materials ratio.
  - a. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
  - b. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

## 2.7 CATCH BASINS

- A. Standard Precast Concrete Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Base Section: Six-inch minimum thickness for floor slab and four-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
2. Top Section: Eccentric-cone type unless flat-slab-top type is indicated.
3. Joint Sealant: ASTM C 990, bitumen or butyl rubber.

- B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16 (heavy traffic) structural loading unless otherwise indicated. Include 24-inch ID by seven- to nine-inch riser with four-inch minimum width flange, and 26-inch-diameter flat grate with small square or short-slotted drainage openings.

1. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

## **PART 3 - EXECUTION**

### **3.1 PIPING APPLICATIONS**

- A. Pipe couplings and fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
  - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
    - a. Shielded flexible couplings for same or minor difference OD pipes.
    - b. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

### **3.2 PIPING INSTALLATION**

- A. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- B. Install manholes for changes in direction if shown on plan, otherwise use fittings. Use fittings for branch connections unless direct tap into existing storm drain is indicated.
- C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- D. Install gravity-flow, nonpressure drainage piping according to the following:
  - 1. Install piping pitched down in direction of flow, at minimum slope of one percent, unless otherwise indicated.
  - 2. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
  - 3. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
- E. Clear interior of piping and manholes of dirt and superfluous material as work progresses.

### **3.3 PIPE JOINT CONSTRUCTION**

- A. Join gravity-flow, nonpressure drainage piping according to the following:
  - 1. 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.
  - 2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
  - 3. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-gasket joints.

4. Join dissimilar pipe materials with nonpressure-type flexible couplings.

### **3.4 MANHOLE INSTALLATION**

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops three inches above finished surface elsewhere, unless otherwise indicated.

### **3.5 CATCH BASIN INSTALLATION**

- A. Set frames and grates to elevations indicated.

### **3.6 CONNECTIONS**

- A. Connect nonpressure, gravity-flow drainage piping to building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."
- B. Make connections to existing piping and underground manholes.
  1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus six-inch overlap, with not less than six inches of concrete with 28-day compressive strength of 3,250 pounds per square inch (psi).

### **3.7 FIELD QUALITY CONTROL**

- A. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
  1. Do not enclose, cover, or put into service before inspection and approval.
  2. Test completed piping systems according to requirements of authorities having jurisdiction.
  3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
  4. Submit separate report for each test.
  5. Hydrostatic Tests: Test sewers according to requirements of authorities having jurisdiction and the following:
    - a. Allowable leakage is maximum of 50 gallons/inch of nominal pipe size per mile of pipe, during 24-hour period.
    - b. Close openings in system and fill with water.
    - c. Purge air and refill with water.
    - d. Disconnect water supply.

- e. Test and inspect joints for leaks.
- 6. Option: Test ductile-iron piping according to AWWA C600, "Hydrostatic Testing" Section. Use test pressure of at least 10 pounds per square inch gauge (psig).
- 7. Air Tests: Test storm drainage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
  - a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
- B. Leaks and loss in test pressure constitute defects that must be repaired.
- C. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

**END OF SECTION 33 41 00**

## **SECTION 44 11 16 - DUST COLLECTION SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to specification section 233113 for Ductwork.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: Provide data on dust collector fan and accessories including dimensions, weight, fan curve with specified operating point clearly plotted, flameless explosion vent information including NFPA 68 calculations, sound power levels at rated capacity, and electrical characteristics and connection requirements.

#### **1.3 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For duct collection system to include in operation and maintenance manuals.

### **PART 2 - PRODUCTS**

#### **2.1 DUST COLLECTOR**

- A. Manufacturers: Donaldson, Torit, Camfil, or approved equal.
- B. Product Requirements:
  - 1. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
  - 2. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
  - 3. Fabrication: Conform to AMCA 99.
  - 4. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
- C. Collector:
  - 1. Collector shall be high efficiency, self-contained, enclosureless style, shaker type dust collector with a cageless filter design.
  - 2. Overall construction shall be of 16 gauge minimum steel. Steel shall be galvanized for corrosion resistance. The exterior shall be finish coated with enamel.

3. Dust collector shall be designed to support the weight of the unit itself and the weight of collected product.
4. The bottom of unit shall be provided with factory installed 2x2x1/4 angles to secure collector to the floor.
5. Contractor shall coordinate inlet, outlet, shaker motor enclosure, access doors, and other connection and appurtenance details with manufacturer to ensure unit is manufactured to avoid potential conflicts with structural, architectural and other site conditions, as well as provide sufficient clearances for installation and maintenance.
6. Collector shall be manufactured at an ISO 9001 certified facility.
7. Dust collector shall be rated for outdoor operation. Electrical components and enclosures located outdoors shall be NEMA 3R rated.

D. Collector Operation:

1. During normal operation dust laden air enters the collector through the fan inlet. Air and entrained dust are direct upward through the elbow and into the plenum. In the plenum, the air and entrained dust are divided among the cells by adjustable distribution vanes. In the cell, the air and entrained dust travels downward through the filter media. Air passes through the media while the finer entrained dust is collected on the inner surface of the bags. Larger entrained dust particles pass directly to the collection bags

E. Filter:

1. Filter cartridge shall consist of individual pockets sewn from one piece of 8.2 ounce cotton sateen fabric designed to deliver in excess of 99% efficiency by weight on fine industrial dusts.
2. Filter cartridge shall have rigid corrugated separators to prevent pocket collapse and to channel cleaned air in a laminar flow profile into fan inlet cone. Adjacent pockets shall be positioned by steel bars at the top and flat shaker “fingers” at the bottom to prevent mutual blank off and to maintain the dust cake collection area.
3. Cartridge shall be fitted over a galvanized steel locking frame and all separators securely positioned by a galvanized steel retainer resulting in a tight pocket assembly to minimize pressure drop and maximize dust release.
4. Each cartridge assembly shall be locked in place by two lever actuated over-center cam assemblies which force the steel header frame securely against a 3/4” x 1.5” neoprene gasket surface.
5. Cartridge access shall be through full height doors with quick opening, flush latches for speed and security.

F. Fan:

1. Fan shall be located upstream of filters.
2. Fan shall be sized to provide airflows and sufficient static pressure to overcome internal losses, including fully-loaded filters, in addition to the external static pressure as shown on the dust collector schedule.
3. Fan shall be statically and dynamically balanced in accordance to AMCA Standard 204-05.
4. Fan shall be factory installed.

G. Motor:



1. Motor housing shall be TEFC.
2. Motor shall be UL listed.
3. Motor capacity and torque characteristics shall be sufficient to start, accelerate and operate connected loads at designated speeds, and without exceeding nameplate ratings or considering service factor.
4. Motor shall be factory installed and wired.

H. Instrumentation & Controls:

1. Control panels shall be provided by the dust collector manufacturer. Control panels and instrumentation will ship loose, to be field installed and wired per manufacturer's instructions. Contractor shall provide all necessary wiring, conduit, instrumentation, accessories and hardware necessary for a complete, fully-functional system as described by the contract documents.
2. Remote start/stop switches located in the space served by the dust collector will be provided to manually start or stop the dust collector. Electrical interlocks to woodworking equipment is described in the electrical plans.
3. Dust collection system shall be connected to building fire alarm system and shut down in the event of an alarm. This will also serve to shut down the dust collector in the event of a fire inside the collector.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Any modifications to building elements (e.g. walls, structural elements, lighting, etc.) necessary to install dust collectors shall be performed in accordance with the plans, or restored to original condition if not included in the planned modifications.
- C. Offset ducts as needed from wall opening to connect to dust collector.
- D. Dust collector manufacturer or authorized technical representative shall provide commissioning of the dust collector system, including associated controls and safety devices, to ensure that the system is functioning correctly.
- E. 8 hours of training on operation and maintenance of the dust collector system shall be provided to personnel of the University's choosing.
- F. Do not operate dust collector for any purpose other than designed for, and not before bearings are lubricated, and remote fan has been test run under observation by owner and manufactures representative.

## **END OF SECTION 44 11 16**

**P2S Inc.**  
005.2882.000

January 10, 2022  
DSA Backcheck

**Long Beach City College**  
**Construction Trades II Building**  
Long Beach, California